

## Aberystwyth University

### *A neoclerodane orthoester and other new neoclerodane diterpenoids from Teucrium yemense chemistry and effect on secretion of insulin*

Nur-e-Alam, Mohammad; Parveen, Ifat; Wilkinson, Barrie; Ahmed, Sarfaraz; Hafizur, Rahman M.; Bari, Ahmed; Woodman, Timothy J.; Threadgill, Michael D.; Al-Rehaily, Adnan J.

*Published in:*  
Scientific Reports

*DOI:*  
[10.1038/s41598-021-87513-3](https://doi.org/10.1038/s41598-021-87513-3)

*Publication date:*  
2021

*Citation for published version (APA):*

Nur-e-Alam, M., Parveen, I., Wilkinson, B., Ahmed, S., Hafizur, R. M., Bari, A., Woodman, T. J., Threadgill, M. D., & Al-Rehaily, A. J. (2021). A neoclerodane orthoester and other new neoclerodane diterpenoids from *Teucrium yemense* chemistry and effect on secretion of insulin. *Scientific Reports*, 11(1), [8074].  
<https://doi.org/10.1038/s41598-021-87513-3>

#### **Document License** CC BY

#### **General rights**

Copyright and moral rights for the publications made accessible in the Aberystwyth Research Portal (the Institutional Repository) are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the Aberystwyth Research Portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the Aberystwyth Research Portal

#### **Take down policy**

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

tel: +44 1970 62 2400  
email: [is@aber.ac.uk](mailto:is@aber.ac.uk)

**A neoclerodane orthoester and other new neoclerodane diterpenoids from *Teucrium yemense* chemistry and effect on secretion of insulin** Mohammad Nur-e-Alam,<sup>1,\*</sup> Ifat Parveen,<sup>2</sup> Barrie Wilkinson,<sup>3</sup> Sarfaraz Ahmed,<sup>1</sup> Rahman M. Hafizur,<sup>4</sup> Ahmed Bari,<sup>5</sup> Timothy J. Woodman,<sup>6</sup> Michael D. Threadgill<sup>2,6</sup> & Adnan J. Al-Rehaily<sup>1</sup>

<sup>1</sup> Department of Pharmacognosy, College of Pharmacy, King Saud University, P.O. Box. 2457, Riyadh 11451, Kingdom of Saudi Arabia  
<sup>2</sup> Institute of Biological, Environmental & Rural Sciences (IBERS), Aberystwyth University, Aberystwyth SY23 3DA, United Kingdom  
<sup>3</sup> John Innes Centre, Norwich Research Park, Norwich, NR4 7UH, United Kingdom  
<sup>4</sup> Dr. Panjwani Center for Molecular Medicine and Drug Research, International Center for Chemical and Biological Sciences, University of Karachi, Karachi-75270, Pakistan  
<sup>5</sup>Department of Pharmaceutical Chemistry, College of Pharmacy, King Saud University, P.O. Box. 2457, Riyadh 11451, Kingdom of Saudi Arabia  
Drug & Target Discovery, Department of Pharmacy and Pharmacology, University of Bath, Claverton Down, Bath, BA2 7AY, United Kingdom

Contents	Page
<b>Table S1.</b>	<sup>1</sup> H and <sup>13</sup> C NMR data for <b>1-3</b> . 9
<b>Table S2.</b>	<sup>1</sup> H and <sup>13</sup> C NMR data for <b>4-7</b> . 10
<b>Table S3.</b>	<sup>1</sup> H and <sup>13</sup> C NMR data for <b>8-11</b> . 11
<b>Table S4.</b>	<sup>1</sup> H and <sup>13</sup> C NMR data for <b>12-14</b> . 12
<b>Table S5.</b>	<sup>1</sup> H and <sup>13</sup> C NMR data for <b>15,16</b> . 13
<b>Table S6.</b>	<sup>1</sup> H and <sup>13</sup> C NMR data for <b>17,18</b> . 14
<b>Table S7.</b>	<sup>1</sup> H and <sup>13</sup> C NMR data for <b>19,20</b> . 15
<b>Figure S1.</b>	<sup>1</sup> H NMR spectrum of <b>1</b> in CD <sub>3</sub> OD. 16
<b>Figure S2.</b>	Expansion of part of <sup>1</sup> H NMR spectrum (δ 1.0 – δ 2.7) of <b>1</b> in CD <sub>3</sub> OD. 17
<b>Figure S3.</b>	Expansion of part of <sup>1</sup> H NMR spectrum (δ 3.7 – δ 5.6) of <b>1</b> in CD <sub>3</sub> OD. 18
<b>Figure S4.</b>	<sup>1</sup> H NMR spectrum of <b>1</b> in (CD <sub>3</sub> ) <sub>2</sub> SO. 19
<b>Figure S5.</b>	<sup>13</sup> C NMR spectrum of <b>1</b> in CD <sub>3</sub> OD. 20
<b>Figure S6.</b>	COSY NMR spectrum of <b>1</b> in CD <sub>3</sub> OD. 21
<b>Figure S7.</b>	HSQC NMR spectrum of <b>1</b> in CD <sub>3</sub> OD. 22
<b>Figure S8.</b>	HMBC NMR spectrum of <b>1</b> in CD <sub>3</sub> OD. 23
<b>Figure S9.</b>	Positive-ion HRESIMS of <b>1</b> . 24
<b>Figure S10.</b>	<sup>1</sup> H NMR spectrum of <b>2</b> in CD <sub>3</sub> OD. 25

<b>Figure S11.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.9 – $\delta$ 3.3) of <b>2</b> in $\text{CD}_3\text{OD}$ .	26
<b>Figure S12.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 3.9 – $\delta$ 5.6) of <b>2</b> in $\text{CD}_3\text{OD}$ .	27
<b>Figure S13.</b>	$^{13}\text{C}$ NMR spectrum of <b>2</b> in $\text{CD}_3\text{OD}$ .	28
<b>Figure S14.</b>	COSY NMR spectrum of <b>2</b> in $\text{CD}_3\text{OD}$ .	29
<b>Figure S15.</b>	HSQC NMR spectrum of <b>2</b> in $\text{CD}_3\text{OD}$ .	30
<b>Figure S16.</b>	HMBC NMR spectrum of <b>2</b> in $\text{CD}_3\text{OD}$ .	31
<b>Figure S17.</b>	Positive-ion HRESIMS of <b>2</b> .	32
<b>Figure S18.</b>	$^1\text{H}$ NMR spectrum of <b>3</b> in $\text{CD}_3\text{OD}$ .	33
<b>Figure S19.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.6 – $\delta$ 2.6) of <b>3</b> in $\text{CD}_3\text{OD}$ .	34
<b>Figure S20.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 3.75 – $\delta$ 4.95) of <b>3</b> in $\text{CD}_3\text{OD}$ .	35
<b>Figure S21.</b>	$^{13}\text{C}$ NMR spectrum of <b>3</b> in $\text{CD}_3\text{OD}$ .	36
<b>Figure S22.</b>	COSY NMR spectrum of <b>3</b> in $\text{CD}_3\text{OD}$ .	37
<b>Figure S23.</b>	NOESY NMR spectrum of <b>3</b> in $\text{CD}_3\text{OD}$ .	38
<b>Figure S24.</b>	HSQC NMR spectrum of <b>3</b> in $\text{CD}_3\text{OD}$ .	39
<b>Figure S25.</b>	HMBC NMR spectrum of <b>3</b> in $\text{CD}_3\text{OD}$ .	40
<b>Figure S26.</b>	Positive-ion HRESIMS of <b>3</b> .	41
<b>Figure S27.</b>	Negative-ion HRESIMS of <b>3</b> .	42
<b>Figure S28.</b>	$^1\text{H}$ NMR spectrum of <b>4</b> in $\text{CD}_3\text{OD}$ .	43
<b>Figure S29.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.5 – $\delta$ 3.0) of <b>4</b> in $\text{CD}_3\text{OD}$ .	44
<b>Figure S30.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 4.3 – $\delta$ 7.7) of <b>4</b> in $\text{CD}_3\text{OD}$ .	45
<b>Figure S31.</b>	$^{13}\text{C}$ NMR spectrum of <b>4</b> in $\text{CD}_3\text{OD}$ / $\text{CDCl}_3$ .	46
<b>Figure S32.</b>	COSY NMR spectrum of <b>4</b> in $\text{CD}_3\text{OD}$ .	47
<b>Figure S33.</b>	NOESY NMR spectrum of <b>4</b> in $\text{CD}_3\text{OD}$ .	48
<b>Figure S34.</b>	HSQC NMR spectrum of <b>4</b> in $\text{CD}_3\text{OD}$ .	49
<b>Figure S35.</b>	HMBC NMR spectrum of <b>4</b> in $\text{CD}_3\text{OD}$ .	50
<b>Figure S36.</b>	Positive-ion HRESIMS of <b>4</b> .	51
<b>Figure S37.</b>	$^1\text{H}$ NMR spectrum of <b>5</b> in $\text{CD}_3\text{OD}$ .	52
<b>Figure S38.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.9 – $\delta$ 3.0) of <b>5</b> in $\text{CD}_3\text{OD}$ .	53
<b>Figure S39.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 5.3 – $\delta$ 7.9) of <b>5</b> in $\text{CD}_3\text{OD}$ .	54
<b>Figure S40.</b>	$^{13}\text{C}$ NMR spectrum of <b>5</b> in $\text{CD}_3\text{OD}$ .	55
<b>Figure S41.</b>	COSY NMR spectrum of <b>5</b> in $\text{CD}_3\text{OD}$ .	56
<b>Figure S42.</b>	HSQC NMR spectrum of <b>5</b> in $\text{CD}_3\text{OD}$ .	57
<b>Figure S43.</b>	HMBC NMR spectrum of <b>5</b> in $\text{CD}_3\text{OD}$ .	58

<b>Figure S44.</b>	Positive-ion HRESIMS of <b>5</b> .	59
<b>Figure S45.</b>	$^1\text{H}$ NMR spectrum of <b>6</b> in $\text{CD}_3\text{OD}$ .	60
<b>Figure S46.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.7 – $\delta$ 3.4) of <b>6</b> in $\text{CD}_3\text{OD}$ .	61
<b>Figure S47.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 4.3 – $\delta$ 7.7) of <b>6</b> in $\text{CD}_3\text{OD}$ .	62
<b>Figure S48.</b>	$^{13}\text{C}$ NMR spectrum of <b>6</b> in $\text{CD}_3\text{OD}$ .	63
<b>Figure S49.</b>	COSY NMR spectrum of <b>6</b> in $\text{CD}_3\text{OD}$ .	64
<b>Figure S50.</b>	HSQC NMR spectrum of <b>6</b> in $\text{CD}_3\text{OD}$ .	65
<b>Figure S51.</b>	HMBC NMR spectrum of <b>6</b> in $\text{CD}_3\text{OD}$ .	66
<b>Figure S52.</b>	Positive-ion HRESIMS of <b>6</b> .	67
<b>Figure S53.</b>	$^1\text{H}$ NMR spectrum of <b>7</b> in $\text{CD}_3\text{OD}$ .	68
<b>Figure S54.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.7 – $\delta$ 2.8) of <b>7</b> in $\text{CD}_3\text{OD}$ .	69
<b>Figure S55.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 3.7 – $\delta$ 7.4) of <b>7</b> in $\text{CD}_3\text{OD}$ .	70
<b>Figure S56.</b>	$^{13}\text{C}$ NMR spectrum of <b>7</b> in $\text{CD}_3\text{OD}$ .	71
<b>Figure S57.</b>	COSY NMR spectrum of <b>7</b> in $\text{CD}_3\text{OD}$ .	72
<b>Figure S58..</b>	NOESY NMR spectrum of <b>7</b> in $\text{CD}_3\text{OD}$ .	73
<b>Figure S59.</b>	HSQC NMR spectrum of <b>7</b> in $\text{CD}_3\text{OD}$ .	74
<b>Figure S60.</b>	HMBC NMR spectrum of <b>7</b> in $\text{CD}_3\text{OD}$ .	75
<b>Figure S61.</b>	Negative-ion HRESIMS of <b>7</b> .	76
<b>Figure S62.</b>	$^1\text{H}$ NMR spectrum of <b>8</b> in $\text{CD}_3\text{OD}$ .	77
<b>Figure S63.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.4 – $\delta$ 2.6) of <b>8</b> in $\text{CD}_3\text{OD}$ .	78
<b>Figure S64.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 2.9 – $\delta$ 4.7) of <b>8</b> in $\text{CD}_3\text{OD}$ .	79
<b>Figure S65.</b>	$^{13}\text{C}$ NMR spectrum of <b>8</b> in $\text{CD}_3\text{OD}$ .	80
<b>Figure S66.</b>	COSY NMR spectrum of <b>8</b> in $\text{CD}_3\text{OD}$ .	81
<b>Figure S67.</b>	NOESY NMR spectrum of <b>8</b> in $\text{CD}_3\text{OD}$ .	82
<b>Figure S68.</b>	HSQC NMR spectrum of <b>8</b> in $\text{CD}_3\text{OD}$ .	83
<b>Figure S69..</b>	HMBC NMR spectrum of <b>8</b> in $\text{CD}_3\text{OD}$ .	84
<b>Figure S70.</b>	Positive-ion HRESIMS of <b>8</b> .	85
<b>Figure S71.</b>	$^1\text{H}$ NMR spectrum of <b>9</b> in $\text{CD}_3\text{OD}$ .	86
<b>Figure S72.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.4 – $\delta$ 2.6) of <b>9</b> in $\text{CD}_3\text{OD}$ .	87
<b>Figure S73.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 2.9 – $\delta$ 4.8) of <b>9</b> in $\text{CD}_3\text{OD}$ .	88
<b>Figure S74.</b>	$^{13}\text{C}$ NMR spectrum of <b>9</b> in $\text{CD}_3\text{OD}$ .	89
<b>Figure S75.</b>	COSY NMR spectrum of <b>9</b> in $\text{CD}_3\text{OD}$ .	90
<b>Figure S76.</b>	NOESY NMR spectrum of <b>9</b> in $\text{CD}_3\text{OD}$ .	91



<b>Figure S77.</b>	HSQC NMR spectrum of <b>9</b> in CD <sub>3</sub> OD.	92
<b>Figure S78.</b>	HMBC NMR spectrum of <b>9</b> in CD <sub>3</sub> OD.	93
<b>Figure S79.</b>	Positive-ion HRESIMS of <b>9</b> .	94
<b>Figure S80.</b>	<sup>1</sup> H NMR spectrum of <b>10</b> in CD <sub>3</sub> OD.	95
<b>Figure S81.</b>	Expansion of part of <sup>1</sup> H NMR spectrum (δ 0.6 – δ 2.7) of <b>10</b> in CD <sub>3</sub> OD.	96
<b>Figure S82.</b>	Expansion of part of <sup>1</sup> H NMR spectrum (δ 3.5 – δ 4.7) of <b>10</b> in CD <sub>3</sub> OD.	97
<b>Figure S83.</b>	<sup>13</sup> C NMR spectrum of <b>10</b> in CD <sub>3</sub> OD.	98
<b>Figure S84.</b>	COSY NMR spectrum of <b>10</b> in CD <sub>3</sub> OD.	99
<b>Figure S85.</b>	HSQC NMR spectrum of <b>10</b> in CD <sub>3</sub> OD.	100
<b>Figure S86.</b>	HMBC NMR spectrum of <b>10</b> in CD <sub>3</sub> OD.	101
<b>Figure S87.</b>	Positive-ion and negative-ion HRESIMS of <b>10</b> .	102
<b>Figure S88.</b>	<sup>1</sup> H NMR spectrum of <b>11</b> in CD <sub>3</sub> OD.	103
<b>Figure S89.</b>	Expansion of part of <sup>1</sup> H NMR spectrum (δ 0.2 – δ 2.6) of <b>11</b> in CD <sub>3</sub> OD.	104
<b>Figure S90.</b>	Expansion of part of <sup>1</sup> H NMR spectrum (δ 3.4 – δ 7.5) of <b>11</b> in CD <sub>3</sub> OD.	105
<b>Figure S91.</b>	<sup>13</sup> C NMR spectrum of <b>11</b> in CD <sub>3</sub> OD.	106
<b>Figure S92.</b>	COSY NMR spectrum of <b>11</b> in CD <sub>3</sub> OD.	107
<b>Figure S93.</b>	NOESY NMR spectrum of <b>11</b> in CD <sub>3</sub> OD.	108
<b>Figure S94.</b>	HSQC NMR spectrum of <b>11</b> in CD <sub>3</sub> OD.	109
<b>Figure S95.</b>	HMBC NMR spectrum of <b>11</b> in CD <sub>3</sub> OD.	110
<b>Figure S96.</b>	<sup>1</sup> H NMR spectrum of <b>12</b> in CD <sub>3</sub> OD.	111
<b>Figure S97.</b>	Expansion of part of <sup>1</sup> H NMR spectrum (δ 0.6 – δ 2.9) of <b>12</b> in CD <sub>3</sub> OD.	112
<b>Figure S98.</b>	Expansion of part of <sup>1</sup> H NMR spectrum (δ 3.6 – δ 7.8) of <b>12</b> in CD <sub>3</sub> OD.	113
<b>Figure S99.</b>	<sup>13</sup> C NMR spectrum of <b>12</b> in CD <sub>3</sub> OD.	114
<b>Figure S100.</b>	COSY NMR spectrum of <b>12</b> in CD <sub>3</sub> OD.	115
<b>Figure S101.</b>	NOESY NMR spectrum of <b>12</b> in CD <sub>3</sub> OD.	116
<b>Figure S102.</b>	HSQC NMR spectrum of <b>12</b> in CD <sub>3</sub> OD.	117
<b>Figure S103.</b>	HMBC NMR spectrum of <b>12</b> in CD <sub>3</sub> OD.	118
<b>Figure S104.</b>	Positive-ion HRESIMS of <b>12</b> .	119
<b>Figure S105.</b>	<sup>1</sup> H NMR spectrum of <b>13</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	120
<b>Figure S106.</b>	Expansion of part of <sup>1</sup> H NMR spectrum (δ 0.9 – δ 5.1) of <b>13</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	121
<b>Figure S107.</b>	<sup>13</sup> C NMR spectrum of <b>13</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	122
<b>Figure S108.</b>	135DEPT NMR spectrum of <b>13</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	123
<b>Figure S109.</b>	COSY NMR spectrum of <b>13</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	124

Figure S110.	HSQC NMR spectrum of <b>13</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	125
Figure S111.	HMBC NMR spectrum of <b>13</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	126
Figure S112.	Positive-ion HRESIMS of <b>13</b> .	127
Figure S113.	Negative-ion HRESIMS of <b>13</b> .	128
Figure S114.	<sup>1</sup> H NMR spectrum of <b>14</b> in CDCl <sub>3</sub> .	129
Figure S115.	Expansion of part of <sup>1</sup> H NMR spectrum (δ 0.7 – δ 2.5) of <b>14</b> in CDCl <sub>3</sub> .	130
Figure S116.	Expansion of part of <sup>1</sup> H NMR spectrum (δ 2.8 – δ 5.2) of <b>14</b> in CDCl <sub>3</sub> .	131
Figure S117.	Expansion of part of <sup>1</sup> H NMR spectrum (δ 6.2 – δ 7.7) of <b>14</b> in CDCl <sub>3</sub> .	132
Figure S118.	<sup>13</sup> C NMR spectrum of <b>14</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	133
Figure S119.	135DEPT NMR spectrum of <b>14</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	134
Figure S120.	COSY <sup>1</sup> H NMR spectrum of <b>14</b> in CDCl <sub>3</sub> .	135
Figure S121.	HSQC NMR spectrum of <b>14</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	136
Figure S122.	HSQC <sup>1</sup> H NMR spectrum of <b>14</b> in CDCl <sub>3</sub> .	137
Figure S123.	Expansion of part of HSQC NMR spectrum (δ 0.7 – δ 2.5) of <b>14</b> in CDCl <sub>3</sub> .	138
Figure S124.	Expansion of part of HSQC NMR spectrum (δ 3.0 – δ 4.9) of <b>14</b> in CDCl <sub>3</sub> .	139
Figure S125.	HMBC NMR spectrum of <b>14</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	140
Figure S126..	Positive-ion HRESIMS of <b>14</b> .	141
Figure S127.	Negative-ion HRESIMS of <b>14</b> .	142
Figure S128.	<sup>1</sup> H NMR spectrum of <b>15</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	143
Figure S129.	Expansion of part of <sup>1</sup> H NMR spectrum (δ 0.8 – δ 3.2) of <b>15</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	144
Figure S130.	Expansion of part of <sup>1</sup> H NMR spectrum (δ 3.1 – δ 5.5) of <b>15</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	145
Figure S131.	<sup>1</sup> H NMR spectrum of <b>15</b> in CDCl <sub>3</sub> .	146
Figure S132.	Expansion of part of <sup>1</sup> H NMR spectrum (δ 0.8 – δ 3.2) of <b>15</b> in CDCl <sub>3</sub> .	147
Figure S133.	Expansion of part of <sup>1</sup> H NMR spectrum (δ 3.3 – δ 5.6) of <b>15</b> in CDCl <sub>3</sub> .	148
Figure S134.	Expansion of part of <sup>1</sup> H NMR spectrum (δ 5.8 – δ 7.8) of <b>15</b> in CDCl <sub>3</sub> .	149
Figure S135.	<sup>13</sup> C NMR spectrum of <b>15</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	150
Figure S136.	135DEPT NMR spectrum of <b>15</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	151
Figure S137.	COSY NMR spectrum of <b>15</b> in CDCl <sub>3</sub> .	152
Figure S138.	Expansion of part of COSY NMR spectrum of <b>15</b> in CDCl <sub>3</sub> .	153
Figure S139.	NOESY NMR spectrum of <b>15</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	154
Figure S140.	HSQC NMR spectrum of <b>15</b> in (CD <sub>3</sub> ) <sub>2</sub> SO.	155
Figure S141.	HSQC NMR spectrum of <b>15</b> in CDCl <sub>3</sub> .	156
Figure S142.	Expansion of part of HSQC NMR spectrum (δ 0.7 – δ 3.2) of <b>15</b> in CDCl <sub>3</sub> .	157

<b>Figure S143.</b>	Expansion of part of HSQC NMR spectrum ( $\delta$ 2.9 – $\delta$ 5.5) of <b>15</b> in $\text{CDCl}_3$ .	158
<b>Figure S144.</b>	HMBC NMR spectrum of <b>15</b> in $(\text{CD}_3)_2\text{SO}$ .	159
<b>Figure S145.</b>	Positive-ion HRESIMS of <b>15</b> .	160
<b>Figure S146.</b>	Negative-ion HRESIMS of <b>15</b> .	161
<b>Figure S147.</b>	$^1\text{H}$ NMR spectrum of <b>16</b> in $(\text{CD}_3)_2\text{SO}$ .	162
<b>Figure S148.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.9 – $\delta$ 3.2) of <b>16</b> in $(\text{CD}_3)_2\text{SO}$ .	163
<b>Figure S149.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 3.6 – $\delta$ 5.5) of <b>16</b> in $(\text{CD}_3)_2\text{SO}$ .	164
<b>Figure S150.</b>	$^1\text{H}$ NMR spectrum of <b>16</b> in $\text{CDCl}_3$ .	165
<b>Figure S151.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.7 – $\delta$ 3.5) of <b>16</b> in $\text{CDCl}_3$ .	166
<b>Figure S152.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 3.7 – $\delta$ 7.9) of <b>16</b> in $\text{CDCl}_3$ .	167
<b>Figure S153.</b>	$^{13}\text{C}$ NMR spectrum of <b>16</b> in $(\text{CD}_3)_2\text{SO}$ .	168
<b>Figure S154.</b>	$^{13}\text{C}$ DEPT NMR spectrum of <b>16</b> in $(\text{CD}_3)_2\text{SO}$ .	169
<b>Figure S155.</b>	COSY NMR spectrum of <b>16</b> in $(\text{CD}_3)_2\text{SO}$ .	170
<b>Figure S156.</b>	COSY NMR spectrum of <b>16</b> in $\text{CDCl}_3$ .	171
<b>Figure S157.</b>	Expansion of part of COSY NMR spectrum ( $\delta$ 0.9 – $\delta$ 5.5) of <b>16</b> in $\text{CDCl}_3$ .	172
<b>Figure S158.</b>	NOESY NMR spectrum of <b>16</b> in $(\text{CD}_3)_2\text{SO}$ .	173
<b>Figure S159.</b>	HSQC NMR spectrum of <b>16</b> in $(\text{CD}_3)_2\text{SO}$ .	174
<b>Figure S160.</b>	HSQC NMR spectrum of <b>16</b> in $\text{CDCl}_3$ .	175
<b>Figure S161.</b>	Expansion of part of HSQC NMR spectrum ( $\delta$ 1.0 – $\delta$ 3.1) of <b>16</b> in $\text{CDCl}_3$ .	176
<b>Figure S162.</b>	Expansion of part of HSQC NMR spectrum ( $\delta$ 2.9 – $\delta$ 5.4) of <b>16</b> in $\text{CDCl}_3$ .	177
<b>Figure S163.</b>	HMBC NMR spectrum of <b>16</b> in $(\text{CD}_3)_2\text{SO}$ .	178
<b>Figure S164.</b>	Positive-ion HRESIMS of <b>16</b> .	179
<b>Figure S165.</b>	$^1\text{H}$ NMR spectrum of <b>17</b> in $(\text{CD}_3)_2\text{SO}$ .	180
<b>Figure S166.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.9 – $\delta$ 2.8) of <b>17</b> in $(\text{CD}_3)_2\text{SO}$ .	181
<b>Figure S167.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 3.6 – $\delta$ 5.5) of <b>17</b> in $(\text{CD}_3)_2\text{SO}$ .	182
<b>Figure S168.</b>	$^1\text{H}$ NMR spectrum of <b>17</b> in $\text{CDCl}_3$ .	183
<b>Figure S169.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.7 – $\delta$ 3.2) of <b>17</b> in $\text{CDCl}_3$ .	184
<b>Figure S170.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 2.8 – $\delta$ 5.8) of <b>17</b> in $\text{CDCl}_3$ .	185
<b>Figure S171.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 6.0 – $\delta$ 7.7) of <b>17</b> in $\text{CDCl}_3$ .	186
<b>Figure S172.</b>	$^{13}\text{C}$ NMR spectrum of <b>17</b> in $(\text{CD}_3)_2\text{SO}$ .	187
<b>Figure S173.</b>	$^{13}\text{C}$ DEPT NMR spectrum of <b>17</b> in $(\text{CD}_3)_2\text{SO}$ .	188
<b>Figure S174.</b>	COSY NMR spectrum of <b>17</b> in $(\text{CD}_3)_2\text{SO}$ .	189
<b>Figure S175.</b>	COSY NMR spectrum of <b>17</b> in $\text{CDCl}_3$ .	190

<b>Figure S176.</b>	Expansion of part of COSY NMR spectrum ( $\delta$ 0.5 – $\delta$ 5.5) of <b>17</b> in $\text{CDCl}_3$ .	191
<b>Figure S177.</b>	HSQC NMR spectrum of <b>17</b> in $(\text{CD}_3)_2\text{SO}$ .	192
<b>Figure S178.</b>	HSQC NMR spectrum of <b>17</b> in $\text{CDCl}_3$ .	193
<b>Figure S179.</b>	Expansion of part of HSQC NMR spectrum ( $\delta$ 0.8 – $\delta$ 2.7) of <b>17</b> in $\text{CDCl}_3$ .	194
<b>Figure S180.</b>	Expansion of part of HSQC NMR spectrum ( $\delta$ 3.6 – $\delta$ 5.6) of <b>17</b> in $\text{CDCl}_3$ .	195
<b>Figure S181.</b>	HMBC NMR spectrum of <b>17</b> in $(\text{CD}_3)_2\text{SO}$ .	196
<b>Figure S182.</b>	Positive-ion HRESIMS of <b>17</b> .	197
<b>Figure S183.</b>	Negative-ion HRESIMS of <b>17</b> .	198
<b>Figure S184.</b>	$^1\text{H}$ NMR spectrum of <b>18</b> in $(\text{CD}_3)_2\text{SO}$ .	199
<b>Figure S185.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.9 – $\delta$ 2.7) of <b>18</b> in $(\text{CD}_3)_2\text{SO}$ .	200
<b>Figure S186.</b>	$^1\text{H}$ NMR spectrum of <b>18</b> in $\text{CDCl}_3$ .	201
<b>Figure S187.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.8 – $\delta$ 3.7) of <b>18</b> in $\text{CDCl}_3$ .	202
<b>Figure S188.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 3.0 – $\delta$ 7.8) of <b>18</b> in $\text{CDCl}_3$ .	203
<b>Figure S189.</b>	$^{13}\text{C}$ NMR spectrum of <b>18</b> in $(\text{CD}_3)_2\text{SO}$ .	204
<b>Figure S190.</b>	$^{13}\text{C}$ DEPT NMR spectrum of <b>18</b> in $(\text{CD}_3)_2\text{SO}$ .	205
<b>Figure S191.</b>	COSY NMR spectrum of <b>18</b> in $(\text{CD}_3)_2\text{SO}$ .	206
<b>Figure S192.</b>	HSQC NMR spectrum of <b>18</b> in $(\text{CD}_3)_2\text{SO}$ .	207
<b>Figure S193.</b>	HMBC NMR spectrum of <b>18</b> in $(\text{CD}_3)_2\text{SO}$ .	208
<b>Figure S194.</b>	Positive-ion HRESIMS of <b>18</b> .	209
<b>Figure S195.</b>	$^1\text{H}$ NMR spectrum of <b>19</b> in $(\text{CD}_3)_2\text{SO}$ .	210
<b>Figure S196.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.75 – $\delta$ 2.3) of <b>19</b> in $(\text{CD}_3)_2\text{SO}$ .	211
<b>Figure S197.</b>	$^{13}\text{C}$ NMR spectrum of <b>19</b> in $(\text{CD}_3)_2\text{SO}$ .	212
<b>Figure S198.</b>	$^{13}\text{C}$ DEPT NMR spectrum of <b>19</b> in $(\text{CD}_3)_2\text{SO}$ .	213
<b>Figure S199.</b>	HSQC NMR spectrum of <b>19</b> in $(\text{CD}_3)_2\text{SO}$ .	214
<b>Figure S200.</b>	HMBC NMR spectrum of <b>19</b> in $(\text{CD}_3)_2\text{SO}$ .	215
<b>Figure S201.</b>	$^1\text{H}$ NMR spectrum of <b>20</b> in $(\text{CD}_3)_2\text{SO}$ .	216
<b>Figure S202.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 0.6 – $\delta$ 2.3) of <b>20</b> in $(\text{CD}_3)_2\text{SO}$ .	217
<b>Figure S203.</b>	Expansion of part of $^1\text{H}$ NMR spectrum ( $\delta$ 2.5 – $\delta$ 4.2) of <b>20</b> in $(\text{CD}_3)_2\text{SO}$ .	218
<b>Figure S204.</b>	$^{13}\text{C}$ NMR spectrum of <b>20</b> in $(\text{CD}_3)_2\text{SO}$ .	219
<b>Figure S205.</b>	$^{13}\text{C}$ DEPT NMR spectrum of <b>20</b> in $(\text{CD}_3)_2\text{SO}$ .	220
<b>Figure S206.</b>	HSQC NMR spectrum of <b>20</b> in $(\text{CD}_3)_2\text{SO}$ .	221
<b>Figure S207.</b>	HMBC NMR spectrum of <b>20</b> in $(\text{CD}_3)_2\text{SO}$ .	222
<b>Figure S208.</b>	Fractionation tree for isolation of compounds <b>1-20</b> .	223

General analytical and chromatographic procedures.	224
Assay for enhancement of insulin secretion.	225

**Table S1.** <sup>1</sup>H and <sup>13</sup>C NMR data for **1-3**.

	<b>1</b> (CD <sub>3</sub> OD)		<b>1</b> ((CD <sub>3</sub> ) <sub>2</sub> SO)	<b>2</b> (CD <sub>3</sub> OD)		<b>3</b> (CD <sub>3</sub> OD)	
Position	δ <sub>H</sub> mult. (J Hz)	δ <sub>C</sub> type	δ <sub>H</sub> mult. (J Hz)	δ <sub>H</sub> mult. (J Hz)	δ <sub>C</sub> type	δ <sub>H</sub> mult. (J Hz)	δ <sub>C</sub> type
1	1.29 m, 1.7 m	22.0 CH <sub>2</sub>		2.22 m, 2.64 brq (13.6)	22.2 CH <sub>2</sub>	1.29 brq (13.2), 2.35 brd (13.0)	21.9 CH <sub>2</sub>
2	1.7 m, 2.19 m	33.9 CH		1.36 d (6.8), 2.22 m	33.0 CH <sub>2</sub>	1.40-1.46 m, 2.09-2.16 m	30.3 CH <sub>2</sub>
3	4.24 dd (10.9, 6.5)	71.4 CH	4.07 m	4.11 dd (10.7, 4.2)	66.4 CH	3.87 dd (11.5, 5.2)	72.8 CH
4	-	87.1 C <sub>q</sub>		-	54.3 C <sub>q</sub>	-	84.107 C <sub>q</sub>
5	-	43.8 C <sub>q</sub>		-	63.6 C <sub>q</sub>	-	49.4 C <sub>q</sub>
6	-	107.8 C <sub>q</sub>		-	206.2 C <sub>q</sub>	-	110.0 C <sub>q</sub>
7	2.03 m, 2.27 dd (14.1, 12.9)	35.2 CH <sub>2</sub>		2.28 dd (15.0, 2.7), 2.72 brt (14.6)	46.2 CH <sub>2</sub>	1.40-1.46 m, 2.09-2.16 m	35.8 <i>or</i> 36.0 CH <sub>2</sub>
8	1.96 m	37.6 CH	1.8 m	1.83 m	42.9 CH	2.21 m	37.2 CH
9	-	51.4 C <sub>q</sub>		-	53.6 C <sub>q</sub>	-	48.5 C <sub>q</sub>
10	1.89 d (11.2)	47.1 CH		2.22 m	54.3 CH	2.24-2.48 m	43.6 CH
11	2.49 m	42.9 CH <sub>2</sub>		1.93 dd (12.5, 11.0), 2.34 dd (13.2, 6.8)	44.2 CH <sub>2</sub>	2.09-2.16 m	33.0 <i>or</i> 35.3 CH <sub>2</sub>
12	5.46 t (8.6)	73.5 CH		5.25 brdd, (9.8, 7.1)	71.2 CH	4.85 brd (9.7)	63.7 CH
13	-	126.3 C <sub>q</sub>		-	124.8 C <sub>q</sub>	-	130.1 C <sub>q</sub>
14	6.47 brs	109.1 CH	6.52 brs	6.41 m	108.8 CH	6.42 m	108.4 CH
15	7.54 brs	145.6 CH	7.72 brs	7.43 m	143.8	7.40 m	143.9 CH
16	7.61 brs	141.8 CH	7.83 brs	7.42 m	139.6 CH	7.39 m	138.7 CH
17	1.08 d (6.8)	16.1 CH <sub>3</sub>	1.00 d (6.7)	1.03 d (6.7)	15.6 CH <sub>3</sub>	0.93 d (6.2)	16.6 CH <sub>3</sub>
18	3.87 d (10.0), 4.39 d (10.0)	58.3 CH <sub>2</sub>	4.31 d (9.8), 3.69 d (9.8)	2.81 d (5.3), 3.14 d (5.3)	43.676 CH <sub>2</sub>	3.90 brd (10.9), 4.45 m	75.8 CH <sub>2</sub>
19	3.93 d (10.2), 4.82 d (10.2)	74.6 CH <sub>2</sub>	3.91 d (10.0), 4.61 d (10.1)	4.72 d (12.7), 4.83 d (12.7)	64.1 CH <sub>2</sub>	4.45 m, 4.68 brd (12.5)	66.4 CH <sub>2</sub>
20	-	179.3 C <sub>q</sub>		5.54 s	99.7 CH	-	172.5 C <sub>q</sub>
MeC(OR) <sub>3</sub>	1.41 s	23.9 CH <sub>3</sub>					
MeC(OR) <sub>3</sub>	-	107.7 C <sub>q</sub>					
HO-3			5.23 d (5.0)				
MeCO <sub>2</sub> -19				2.07 s	21.1 CH <sub>3</sub>		
MeCO <sub>2</sub> -19				-	171.2 C <sub>q</sub>		
MeO-6						3.40 s	48.9 CH <sub>3</sub>

<sup>a</sup>Only selected peaks shown

**Table S2.** <sup>1</sup>H and <sup>13</sup>C NMR data for **4-7**.

Position	4 (CD <sub>3</sub> OD)		5 (CD <sub>3</sub> OD)		6 (CD <sub>3</sub> OD)		7 (CD <sub>3</sub> OD)	
	$\delta_{\text{H}}$ mult. (J Hz)	$\delta_{\text{C}}$ type	$\delta_{\text{H}}$ mult. (J Hz)	$\delta_{\text{C}}$ type	$\delta_{\text{H}}$ mult. (J Hz)	$\delta_{\text{C}}$ type	$\delta_{\text{H}}$ mult. (J Hz)	$\delta_{\text{C}}$ type
1	1.64 m, 2.3 m	29.9 CH <sub>2</sub>	1.51 brq (11.3), 2.30 m	23.2 CH <sub>2</sub>	1.65 m, 2.39 m	22.2 CH <sub>2</sub>	1.3 m, 2.45 m	22.8 CH <sub>2</sub>
2	1.66 m, 2.01 m	21.6 CH <sub>2</sub>	1.67 brq (11.3), 2.14 m	29.0 CH <sub>2</sub>	1.65 m, 2.01 m	31.3 CH <sub>2</sub>	1.45 m, 2.05 m	32.8 CH <sub>2</sub>
3	4.41 m	60.5 CH	5.59 m	64.7 CH	4.41 m	61.6 CH	3.83 dd (11.6, 5.9)	73.4 CH
4	-	128.5 C <sub>q</sub>	-	133.9 C <sub>q</sub>	-	133.0 C <sub>q</sub>	-	85.6 C <sub>q</sub>
5	-	163.0 C <sub>q</sub>	-	162.9 C <sub>q</sub>	-	162.4 C <sub>q</sub>	-	49.7 C <sub>q</sub>
6	-	102.4 C <sub>q</sub>	-	103.5 C <sub>q</sub>	-	105.8 C <sub>q</sub>	-	108.2 C <sub>q</sub>
7	2.2 m (0.5 H), 2.3 m (0.5 H), 2.4 m (0.5 H), 2.6 m (0.5 H)	39.9 CH <sub>2</sub>	2.30 m 2.91 m	37 CH <sub>2</sub>	2.18 m, 2.28 t (9.7)	40.8 CH <sub>2</sub>	1.48 m, 2.25 m	36.3 CH <sub>2</sub>
8	2.2 m	36.1 CH	2.37 m	41.7 CH	2.18 m	37.0 CH	2.27 m	34.9 CH
9	-	54.0 C <sub>q</sub>	-	56.1 C <sub>q</sub>	-	55.2 C <sub>q</sub>	-	50.2 C <sub>q</sub>
10	2.85 m	39.9 CH	1.91 m	39.2 CH	2.85 t (8.3)	41.4 CH	-	43.9 CH
11	2.56 dd (14.2, 8.7, 0.5 H), 2.57 dd (13.6, 8.5, 0.5 H), 2.73 dd (14.3, 8.7, 1.0 H)	40.2 CH <sub>2</sub>	2.51 dd (13.9, 9.0), 2.74 dd (14.1, 8.2)	40.4 CH <sub>2</sub>	2.56 dd (14.4, 8.5), 2.73 dd (14.3, 8.8)	40.7 CH <sub>2</sub>	1.6 m, 2.25 m	41.3 CH <sub>2</sub>
12	5.60 t (8.6, 0.5 H), 5.61 t (8.6, 0.5 H)	72.3 CH	5.53 dd (8.6, 7.6)	74.1 CH	5.60 t (8.6)	74.0 CH	4.6 m	64.0 CH
13	-	124.7 C <sub>q</sub>	-	126.5 C <sub>q</sub>	-	126.5 C <sub>q</sub>	-	108.1 C <sub>q</sub>
14	6.49 m	107.9 CH	6.52 m	109.2 CH	6.49 m	109.2 CH	7.17 m	146.6 CH
15	7.54 d (1.7, 0.5 H), 7.55 d (1.8, 0.5 H)	139.6 CH	7.56 m	145.7 CH	7.55 m	145.6 CH	5.88 m	99.0 CH
16	7.61 m	144.3 CH	7.65 m	141.8 CH	7.62 m	141.5 CH	-	172.2 C <sub>q</sub>
17	1.00 d (6.4, 1.5 H), 1.01 d (6.4, 1.5 H)	16.4 CH <sub>3</sub>	1.17 d (6.9)	16.8 CH <sub>3</sub>	1.00 d (6.4)	16.9 CH <sub>3</sub>	1.00 d (6.4)	16.5 CH <sub>3</sub>
18	-	170.1 C <sub>q</sub>	-	179 C <sub>q</sub>	-	170.5 C <sub>q</sub>	3.97 d (10.4), 4.35 d (10.4)	75.8 CH <sub>2</sub>
19	-	-	-	-	-	-	4.58 d (12), 4.64 d (12)	68.2 CH <sub>2</sub>
20	-	176.4 C <sub>q</sub>	-	178.3 C <sub>q</sub>	-	178.6 C <sub>q</sub>	-	174.6 C <sub>q</sub>
MeCO <sub>2</sub> -6	-	-	2.05 s	20.9 CH <sub>3</sub>	-	-	-	-
MeCO <sub>2</sub> -6	-	-	-	172.0 C <sub>q</sub>	-	-	-	-
MeO-6	-	-	-	-	3.19 s	51.0 CH <sub>3</sub>	-	-

**Table S3.** <sup>1</sup>H and <sup>13</sup>C NMR data for **8-11**.

Position	8 (CD <sub>3</sub> OD)		9 (CD <sub>3</sub> OD)		10 (CD <sub>3</sub> OD)		11 (CDCl <sub>3</sub> )	
	$\delta_H$ mult. (J Hz)	$\delta_C$ type	$\delta_H$ mult. (J Hz)	$\delta_C$ type	$\delta_H$ mult. (J Hz)	$\delta_C$ type	$\delta_H$ mult. (J Hz)	$\delta_C$ type
1	1.7 m, 2.1 m	21.9 CH <sub>2</sub>	1.79 m, 2.15 m	22.4 CH <sub>2</sub>	1.3 m, 2.39 m	22.7 CH <sub>2</sub>	1.95 m, 1.99 m	23.2 CH <sub>2</sub>
2	2.2 m, 1.4 m	35.1 or 35.2 CH <sub>2</sub>	1.35 m, 2.10 m	34.4 CH <sub>2</sub>	1.4 m, 2.03 m	32.8 CH <sub>2</sub>	1.41 brdq (2.9, 9.3), 2.15 m	30.3 CH <sub>2</sub>
3	4.00 m	66.5 CH	4.00 brdd (11.5, 4.0)	66.64 or 66.55 CH	3.83 dd (9.4, 4.6)	73.3 CH	3.90 d (7.5)	73.2 CH
4	-	66.9 C <sub>q</sub>	-	70.6 C <sub>q</sub>	-	85.6 C <sub>q</sub>	-	83.9 C <sub>q</sub>
5	-	44.5 C <sub>q</sub>	-	44 C <sub>q</sub>	-	50.2 C <sub>q</sub>	-	50.8 C <sub>q</sub>
6	3.78 dd (8.1, 7.7)	74.3 CH	3.78 dd (8.1, 7.7)	74.5 CH	-	108.1 C <sub>q</sub>	-	110.9 C <sub>q</sub>
7	-	30.8 CH <sub>2</sub>	1.65 m, 1.75 m	38.1 CH <sub>2</sub>	1.45 m, 2.2 m	41.2 CH <sub>2</sub>	1.65 t (10.1), 2.36 dd (10.3, 3.9)	36.1 CH <sub>2</sub>
8	1.7	35.1 or 35.2 CH	1.94 m	35.4 CH	2.28 m	36.3 CH	1.86 m	35.2 CH
9	-	48 C <sub>q</sub>	-	43.5 C <sub>q</sub>	-	36.2 C <sub>q</sub>	-	44.6 C <sub>q</sub>
10	1.7 m	47 CH	2.22 brd (14.9)	47.5 CH	2.23 m	43.9 CH	2.13 m	37.8 CH
11	1.4 m, 2.25 m	34.6 CH <sub>2</sub>	1.75 m	38.0 CH <sub>2</sub>	1.89 dd (12.2, 9.6), 2.43 m	34.2 CH <sub>2</sub>	1.85 m, 2.24 brdd (9,3)	40.5 CH <sub>2</sub>
12	2.15 m, 2.28 m	19.3 CH <sub>2</sub>	4.56 brt (7)	63.8 CH <sub>2</sub>	4.76 m	65.8 CH	5.10 m	71.6 CH
13	-	138.9 C <sub>q</sub>	-	144.1 C <sub>q</sub>	3.1 m	49.7 CH	-	126.7 C <sub>q</sub>
14	7.02 d (2.2)	144.8 CH	7.13 brs	144.8 CH	14.2 m, 2.04 m	33 CH <sub>2</sub>	6.41 m	108.6 CH
15	5.84 d (1.9)	104.6 CH	5.88 brs	104.6 CH	-	174.5 C <sub>q</sub>	7.43 m	143.6 CH
16	-	173.3 C <sub>q</sub>	-	171.7 C <sub>q</sub>	-	173.1 C <sub>q</sub>	7.43 m	139.3 CH
17	0.97 d (6.0)	16.5 CH <sub>3</sub>	1.00 (6.7)	16.7 CH <sub>3</sub>	0.94 br	16.4 CH <sub>3</sub>	1.02 d (6.0)	16.3 CH <sub>3</sub>
18	3.21 d (3.8), 3.01 d (3.8)	42 CH <sub>2</sub>	2.98 d (4.2), 3.17 d (3.9)	43 CH <sub>2</sub>	3.97 d (10.5), 4.34 d (10.5)	75.6 CH <sub>2</sub>	3.89 d (7.5), 4.42 d (7.7)	75.1 CH <sub>2</sub>
19	4.65 d (12.2), 4.43 d (12.2)	63.7 CH <sub>2</sub>	4.12 d (13.5), 4.71 d (13.5)	63.9 CH <sub>2</sub>	4.59 d (12.3), 4.65 d (12.3)	68.5 CH <sub>2</sub>	3.94 d (9.1), 4.15 d (9.1)	58.5 CH <sub>2</sub>
20	3.97 d (12.0), 4.03 d (12.0)	66.5 CH <sub>2</sub>	3.89 d (13.5, 0.5 H), 3.90 d (13.5, 0.5 H), 3.94 d (13.5, 0.5 H), 3.95 d (13.5, 0.5 H)	66.64 or 66.55 CH <sub>2</sub>	-	174.5 C <sub>q</sub>	5.08 s	101.1 CH
MeCO <sub>2</sub> -19	2.06 s	20.98 or 21.03 CH <sub>3</sub>	2.02 s	21.0 CH <sub>3</sub>				
MeCO <sub>2</sub> -19		172.7 C <sub>q</sub>	-	172.8 C <sub>q</sub>				
MeCO <sub>2</sub> -20	2.06 s	20.98 or 21.03 CH <sub>3</sub>	2.01 s	21.0 CH <sub>3</sub>				
MeCO <sub>2</sub> -20		172.7 C <sub>q</sub>	-	172.5 C <sub>q</sub>				
MeO-6							3.37 s	48.1 CH <sub>3</sub>
MeO-15	3.52 s	57.3 CH <sub>3</sub>	3.54 s (1.5 H), 3.55 s (1.5 H)	57.4 CH <sub>3</sub>				



**Table S4.** <sup>1</sup>H and <sup>13</sup>C NMR data for **12-14**.

<b>12</b> (CD <sub>3</sub> OD)			<b>13</b> ((CD <sub>3</sub> ) <sub>2</sub> SO)		<b>14</b> ((CD <sub>3</sub> ) <sub>2</sub> SO)		<b>14</b> (CDCl <sub>3</sub> )	
Position	δ <sub>H</sub> mult. (J Hz)	δ <sub>C</sub> type	δ <sub>H</sub> mult. (J Hz)	δ <sub>C</sub> type	δ <sub>H</sub> mult. (J Hz)	δ <sub>C</sub> type	δ <sub>H</sub> mult. (J Hz)	δ <sub>C</sub> type
1	1.78 m, 2.12 m	23.1 CH <sub>2</sub>	1.86 m, 1.98 m	24.3 CH <sub>2</sub>	1.75 m, 2.05 m	21.5 CH <sub>2</sub>	1.92 brd (10.5), 2.15 m	40.1 CH <sub>2</sub>
2	1.45 m, 2.22 m	34.1 CH <sub>2</sub>	1.27 m, 1.87 m	31.6 CH <sub>2</sub>	1.17 dd (11, 4), 1.91 m	43.5 CH <sub>2</sub>	1.31 dq (4.5, 12.0), 2.18 m	32.9 CH <sub>2</sub>
3	4.28 m	68.6 CH	-	57.7 C <sub>q</sub>	3.80 brd (11)	65.0 CH	4.02 dd (12.0, 4.5)	66.0 CH
4	-	52.8 C <sub>q</sub>	3.66 dd (11, 4), 3.27 dd (11, 5)	62.5 CH <sub>2</sub>	-	70.0 C <sub>q</sub>	-	nd
5	-	48.0 C <sub>q</sub>	-	59.3 C <sub>q</sub>	-	45.5 C <sub>q</sub>	-	nd
6	4.99 m	74.7 CH	3.36 dd (11, 4)	69.4 CH	3.62 brd (11)	73.3 CH	3.70 dd (10.0, 6.0)	73.6 CH
7	1.56 m, 2.22 m	33.5 CH <sub>2</sub>	1.21 q (11), 1.47 m	37.9 CH <sub>2</sub>	1.39 brd (12), 1.52 brq (12)	34.7 CH <sub>2</sub>	1.65 m	34.0 CH <sub>2</sub>
8	1.78 m	38.7 CH	1.47 m	35.6 CH	1.68 m	34 CH	1.73 m	35.6 CH
9	-	52.0 C <sub>q</sub>	-	40.4 C <sub>q</sub>	-	43.3 C <sub>q</sub>	-	nd
10	1.89 m	51.8 CH	2.07 dd (12, 5)	51.5 CH	1.96 brd (11)	46.8 CH	2.02 dd (13.0, 2.5)	48.3 CH
11	2.38 m, 2.51 m	43.6 CH <sub>2</sub>	1.60 dd (16, 4), 2.01 dd 16, 9)	41.7 CH <sub>2</sub>	1.67 m, 1.86 m	39.7 CH <sub>2</sub>	1.80 dd (16.0, 2.0), 2.17 m	32.9 CH <sub>2</sub>
12	5.48 m	73.5 CH	4.68 m	62.1 CH	4.59 m	61.7 CH	4.86 brd (8.5)	63.3 CH
13	-	126.7 C <sub>q</sub>	-	132.4 C <sub>q</sub>	-	132.8 C <sub>q</sub>	-	nd
14	6.46 m	109.17 CH	6.46 m	109.7 CH	6.42 m	109.6 CH	6.41 m	108 CH
15	7.53 m	145.6 CH	7.56 m	143.5 CH	7.56 m	143.6 CH	7.39 m	138 CH
16	7.59 m	141.4 CH	7.50 m	143.5 CH	7.49 m	138.6 CH	7.39 m	138 CH
17	0.99 m	16.9 CH <sub>3</sub>	0.71 d (7)	16.3 CH <sub>3</sub>	0.82 d (6)	17.0 CH <sub>3</sub>	0.93 d (6.5)	17.0 CH <sub>3</sub>
18	2.72 br, 2.82 br	42.5 CH <sub>2</sub>	4.76 d (7)	102.0 CH	2.83 m, 3.06 m	43.0 CH <sub>2</sub>	3.03 d (4.0), 3.13 d (3.5)	43.5 CH <sub>2</sub>
19	3.90 d (9.4), 4.62 d (9.3)	61.4 CH <sub>2</sub>	3.80 d (9), 3.87 d (9)	67.3 CH	4.40 d (12), 4.57 d (12)	62.4 CH <sub>2</sub>	4.48 d (12.0), 4.68 d (12.0)	62.5 CH <sub>2</sub>
20	-	178.9 C <sub>q</sub>	3.21 dd (11, 5), 3.32 dd (11, 5)	63.3 CH <sub>2</sub>	3.28 m	63.0 CH <sub>2</sub>	3.59 s (2 H)	64.3 CH <sub>2</sub>
MeCO <sub>2</sub> -6	2.04 s	21.3 CH <sub>3</sub>						
MeCO <sub>2</sub> -6		171.6 C <sub>q</sub>						
HO-3			4.68 br	-		nd		
HO-4	4.46 m	-						
HO-6	4.46 m	-	3.28 m	-		nd		
HO-12	5.02 d (5)	-	4.90 br	-		nd		
HO-18	6.26 d (7)	-						
HO-20	4.46 m	-	4.90 br	-		nd		

**Table S5.** <sup>1</sup>H and <sup>13</sup>C NMR data for **15,16**. nd = not observed

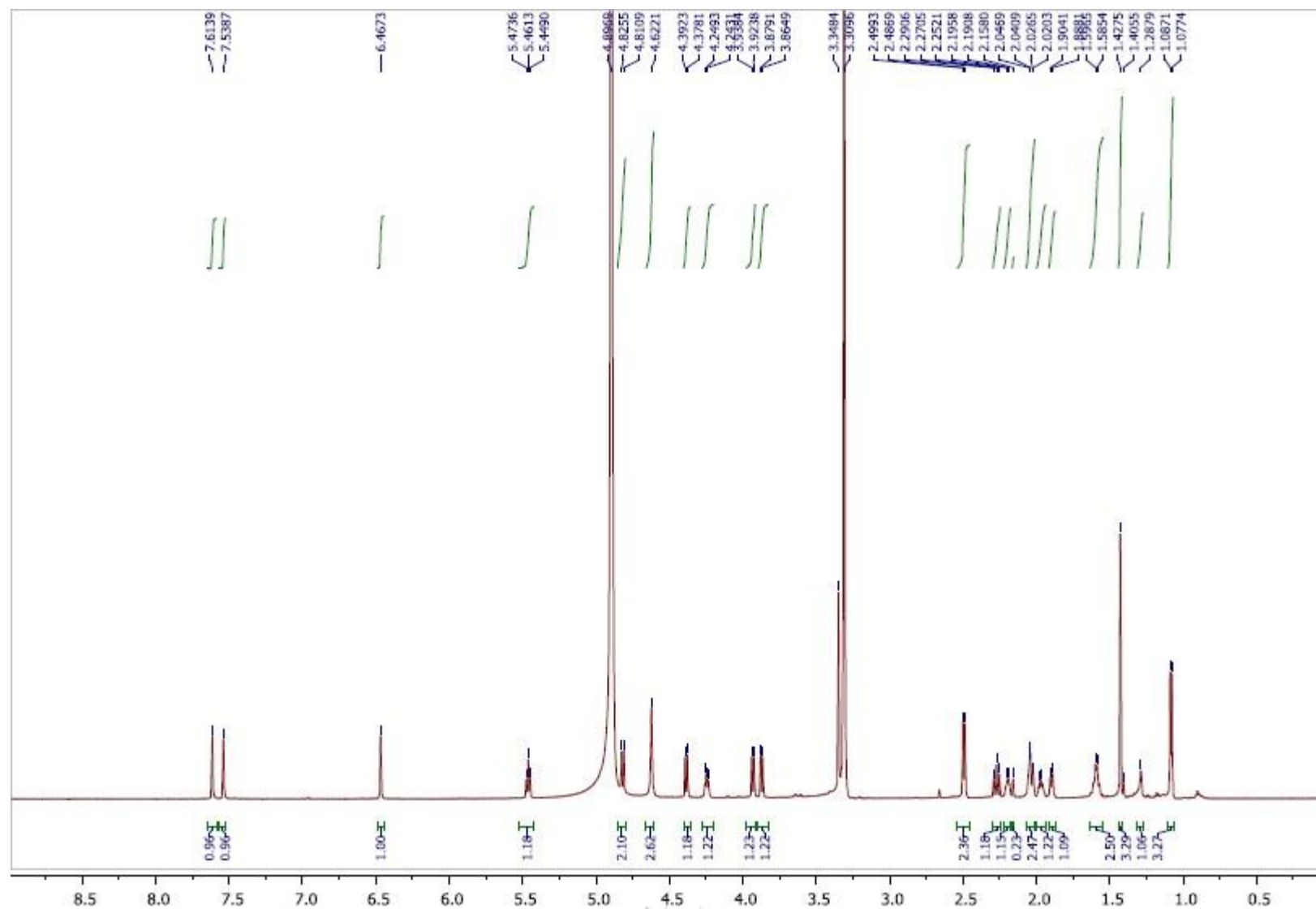
Position	<b>15 ((CD<sub>3</sub>)<sub>2</sub>SO)</b>		<b>15 (CDCl<sub>3</sub>)</b>		<b>16 ((CD<sub>3</sub>)<sub>2</sub>SO)</b>		<b>16 (CDCl<sub>3</sub>)</b>	
	<b>δ<sub>H</sub> mult. (J Hz)</b>	<b>δ<sub>C</sub> type</b>	<b>δ<sub>H</sub> mult. (J Hz)</b>	<b>δ<sub>C</sub> type</b>	<b>δ<sub>H</sub> mult. (J Hz)</b>	<b>δ<sub>C</sub> type</b>	<b>δ<sub>H</sub> mult. (J Hz)</b>	<b>δ<sub>C</sub> type</b>
1	1.59 brq (12), 1.96 m	22.0 CH <sub>2</sub>	1.83 dq (4.5, 13.0), 1.95 m	22.1 CH <sub>2</sub>	1.43 m, 1.68 brd (12)	21.5 CH <sub>2</sub>	1.70 m (2 H)	21.5 CH <sub>2</sub>
2	1.30 dq (4, 12), 2.05 m	34.1 CH <sub>2</sub>	1.40 dq (5.0, 12.5), 2.30 m	32.5 CH <sub>2</sub>	1.20 dq (11, 4), 2.00 m	34.1 CH <sub>2</sub>	1.30 dd (14.0, 8.0), 2.26 m	32.2 CH <sub>2</sub>
3	4.19 m	64.3 CH	4.43 ddd (13.0, 5.0, 2.0)	64.8 CH	4.16 t (10,4)	64.5 CH	4.47 ddd (10.0, 5.0, 3.5)	65.1 CH
4	-	68.8 C <sub>q</sub>	-	nd	-	68.8 C <sub>q</sub>	-	nd
5	-	46.4 C <sub>q</sub>	-	nd	-	46.2 C <sub>q</sub>	-	nd
6	3.67 m	72.5 CH	3.73 dd (12.0, 4.0)	73.9 CH	3.65 m	72.5 CH	3.75 dd (13.5, 3.5)	74.3 CH
7	1.48 brd (12), 1.96 m	34.9 CH <sub>2</sub>	1.69 dt (13.0, 4.0), 2.17 q (12.5)	33.4 CH <sub>2</sub>	1.43 m, 1.74 m	35.6 CH <sub>2</sub>	1.65 dt (13.0, 3.5), 2.08 brq (12.0)	33.6 CH <sub>2</sub>
8	1.62 m	37.3 CH	1.58 m	38.3 CH	1.74 m	40.0 CH	1.70 m	41.1 CH
9	-	51.5 C <sub>q</sub>	-	nd	-	51.5 C <sub>q</sub>	-	nd
10	1.67 brd (12)	51.2 CH	1.60 dd (13.0, 3.0)	52.1 CH	1.50 brd (12)	49.2 CH	1.45 dd (12.0, 4.0)	49.8 CH
11	2.25 dd (10, 7), 2.45 dd (10, 7)	41.2 CH <sub>2</sub>	2.34 d (8.5)	nd	2.33 dd (11, 7), 2.41 dd (11, 7)	42.6 CH <sub>2</sub>	2.32 dd (14.0, 8.0), 2.42 m	43.8 CH <sub>2</sub>
12	5.43 t (7)	71.4 CH	5.34 t (8.5)	71.5 CH	5.42 t (7)	71.3 CH	5.36 t (8.5)	71.3 CH
13	-	125.6 C <sub>q</sub>	-	nd	-	125.8 C <sub>q</sub>	-	nd
14	6.49 m	109.1 CH	6.36 m	107 CH	6.51 m	109.3 CH	6.35 m	107.5 CH
15	7.74 m	145.0 CH	7.42 m	143 CH	7.71 m	145.0 CH	7.45 m	139 CH
16	7.78 m	141.1 CH	7.42 m	139 CH	7.77 m	140.7 CH	7.43 m	139 m
17	0.91 d (6)	16.9 CH <sub>3</sub>	1.01 d (7.0)	16.5 CH <sub>3</sub>	1.00 d (6)	17.3 CH <sub>3</sub>	1.13 d (7.0)	17.0 CH <sub>3</sub>
18	2.69 d (4), 2.89 d (4)	40.6 CH <sub>2</sub>	2.99 d (4.0), 3.01 d (4.0)	42.2 CH <sub>2</sub>	2.65 d (4), 2.83 d (4)	40.9 CH <sub>2</sub>	2.97 d (4.0), 3.00 d (3.5)	42.4 CH <sub>2</sub>
19	3.69 m, 4.36 m	59.3 CH <sub>2</sub>	3.88 dd (12.5, 10.0), 4.73 (12.5, 3.5)	60.7 CH <sub>2</sub>	3.76 dd (11, 8), 4.40 dd (11, 2)	60.1 CH <sub>2</sub>	4.00 dd (13.5, 11.0), 4.76 dd (13.5, 4.0)	61.5 CH <sub>2</sub>
20	-	177.0 C <sub>q</sub>	-	nd	-	176.8 C <sub>q</sub>	-	nd
HO-3	4.66 d (4)		2.82 br		4.60 d (4)		2.12 d (5.0)	
HO-6	3.99 br				4.03 brd (7)		nd	
HO-19	4.07 m		2.69 dd (10.0, 3.5)		4.10 brd (8)		2.42 m	

**Table S6.** <sup>1</sup>H and <sup>13</sup>C NMR data for **17,18**. nd = not observed

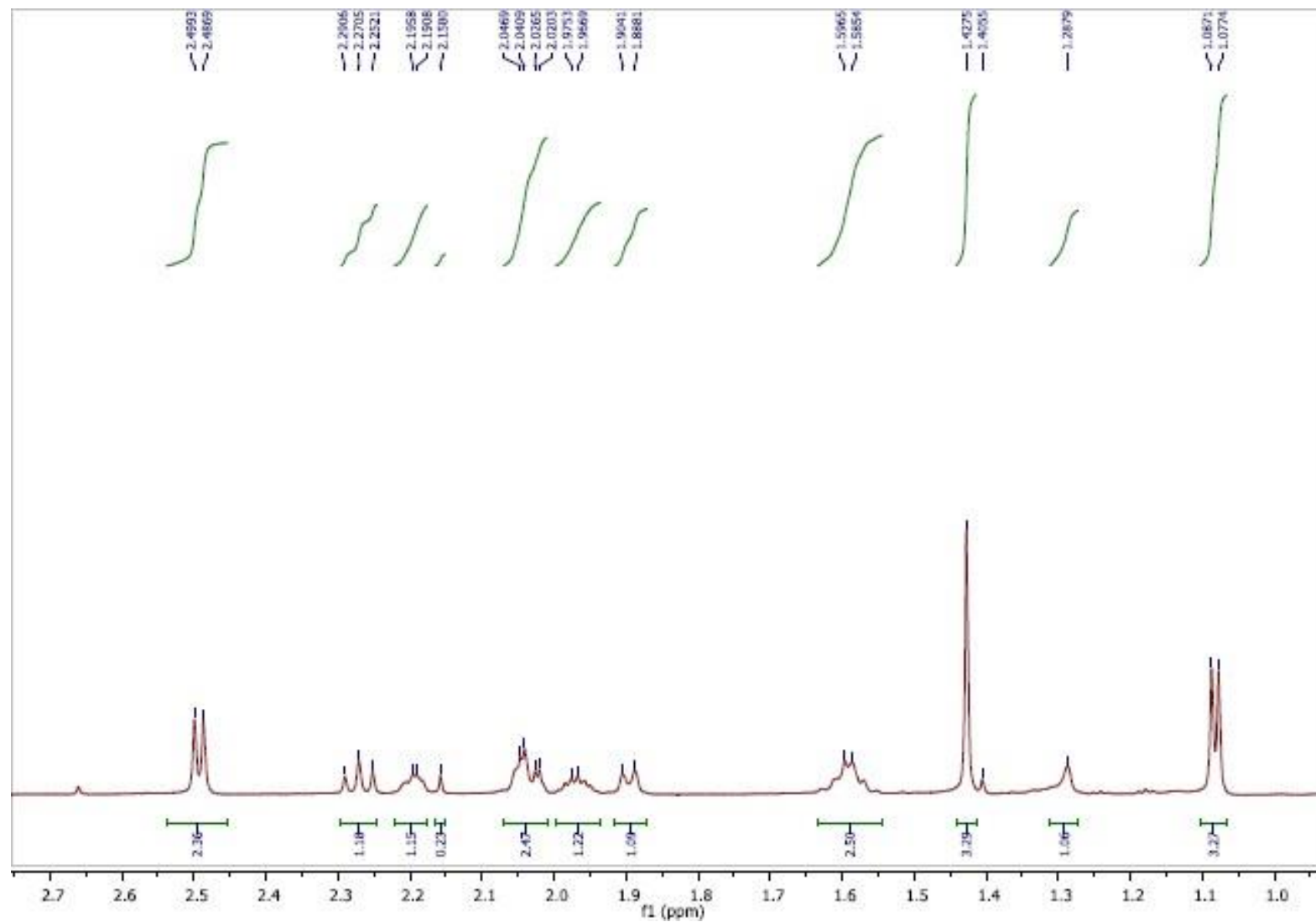
<b>17 ((CD<sub>3</sub>)<sub>2</sub>SO)</b>			<b>17 (CDCl<sub>3</sub>)</b>		<b>18 ((CD<sub>3</sub>)<sub>2</sub>SO)</b>		<b>18 (CDCl<sub>3</sub>)</b>
<b>Position</b>	<b>δ<sub>H</sub> mult. (J Hz)</b>	<b>δ<sub>C</sub> type</b>	<b>δ<sub>H</sub> mult. (J Hz)</b>	<b>δ<sub>C</sub> type</b>	<b>δ<sub>H</sub> mult. (J Hz)</b>	<b>δ<sub>C</sub> type</b>	<b>δ<sub>H</sub> mult. (J Hz)</b>
1	1.95 m, 2.0 m	22.6 CH <sub>2</sub>	1.91 m, 2.12 m	22 CH <sub>2</sub>	1.25 brq (12), 2.27 m	71.6 CH <sub>2</sub>	1.13 m, 2.22 m
2	1.80 m, 2.45 m	36 CH <sub>2</sub>	1.50 dd (12.5, 5.0)	28 CH <sub>2</sub>	1.39 dq (3, 12)	33.0 CH <sub>2</sub>	1.4 m
3	5.45 m	71.4 CH	5.54 dd (12.5, 5.0)	55 CH	4.06 m	51.5 CH	4.44 m
4	-	76.9 C <sub>q</sub>	-	nd	-	139.5 C <sub>q</sub>	-
5	-	48.2 C <sub>q</sub>	-	nd	-	137.4 C <sub>q</sub>	-
6	4.20 brd (11)	72.8 CH	4.21 brd (11.0)	54 CH	-	109.16 C <sub>q</sub>	-
7	1.54 m, 1.87 brq (11)	36.1 CH <sub>2</sub>	1.70 m, 2.20 brq (12.5)	35 CH <sub>2</sub>	1.82 dd (13, 3), 2.27 t (13)	39.6 CH <sub>2</sub>	1.99 dd (13.5, 4.0), 2.22 m
8	1.70 m	37.7 CH	1.70 m	39 CH	2.01 m	35.8 CH	2.09 m
9	-	51.7 C <sub>q</sub>	-	51 C <sub>q</sub>	-	53.0 C <sub>q</sub>	-
10	1.80 m	42.6 CH	1.87 m	49 CH	2.45 m	40 CH	2.48 m
11	2.32 dd (12, 9), 2.45 m	43.1 CH <sub>2</sub>	2.40 d (8.5)	44 CH <sub>2</sub>	2.42 dd (12, 8), 2.57 dd (12, 8)	40 CH <sub>2</sub>	2.48 m
12	5.45 m	74.0 CH	5.35 t (8.5)	71 CH	5.48 t (8)	71.6 CH	5.38 t (8.5)
13	-	125.7 C <sub>q</sub>	-	124 C <sub>q</sub>	-	125.4 C <sub>q</sub>	-
14	6.51 m	109.1 CH	6.38 m	109 CH	6.52 m	109.20 CH	6.39 m
15	7.71 m	144.9 CH	7.44 m	143 CH	7.72 t (3)	145.0	7.45 m
16	7.79 m	141.2 CH	7.44 m	139 CH	7.82 m	141.2	7.45 m
17	0.96 d (6)	16.8 CH <sub>3</sub>	1.06 d (7.5)	17 CH <sub>3</sub>	0.92 d (7)	17.2 CH <sub>3</sub>	0.99 d (6.5)
18	3.43 dd (10, 3), 4.04 dd (10, 5)	61.1 CH <sub>2</sub>	4.04 brd (12.0), 4.09 brd (12.0)	60.5 CH <sub>2</sub>	6.02 s	107.0 CH	6.21 s
19	4.77 d (12), 4.86 d (12)	63.9 (CH <sub>2</sub> )	5.06 d (13.0), 5.08 d (13.0)	63 CH <sub>2</sub>			
20	-	177.1 C <sub>q</sub>	-	nd	-	176.6 C <sub>q</sub>	-
MeCO <sub>2</sub> -3	2.05 s	21.6 CH <sub>3</sub>	2.11 s	21 CH <sub>3</sub>			
MeCO <sub>2</sub> -3	-	170.4 C <sub>q</sub>	-	170 C <sub>q</sub>			
MeCO <sub>2</sub> -19	2.00 s	21.8 CH <sub>3</sub>	2.10 s	21 CH <sub>3</sub>			
MeCO <sub>2</sub> -19	-	169.9 C <sub>q</sub>	-	170 C <sub>q</sub>			
HO-3					5.06 d (7)		nd
HO-4	4.39 br		nd				
HO-6	5.06 m		nd				
HO-18	5.06 m		nd				
MeO-6					2.97 s	49.0 CH <sub>3</sub>	3.11 s
MeO-18					3.15 s	51.5 CH <sub>3</sub>	3.39 s

**Table S7.**  $^1\text{H}$  and  $^{13}\text{C}$  NMR data for **19,20**.

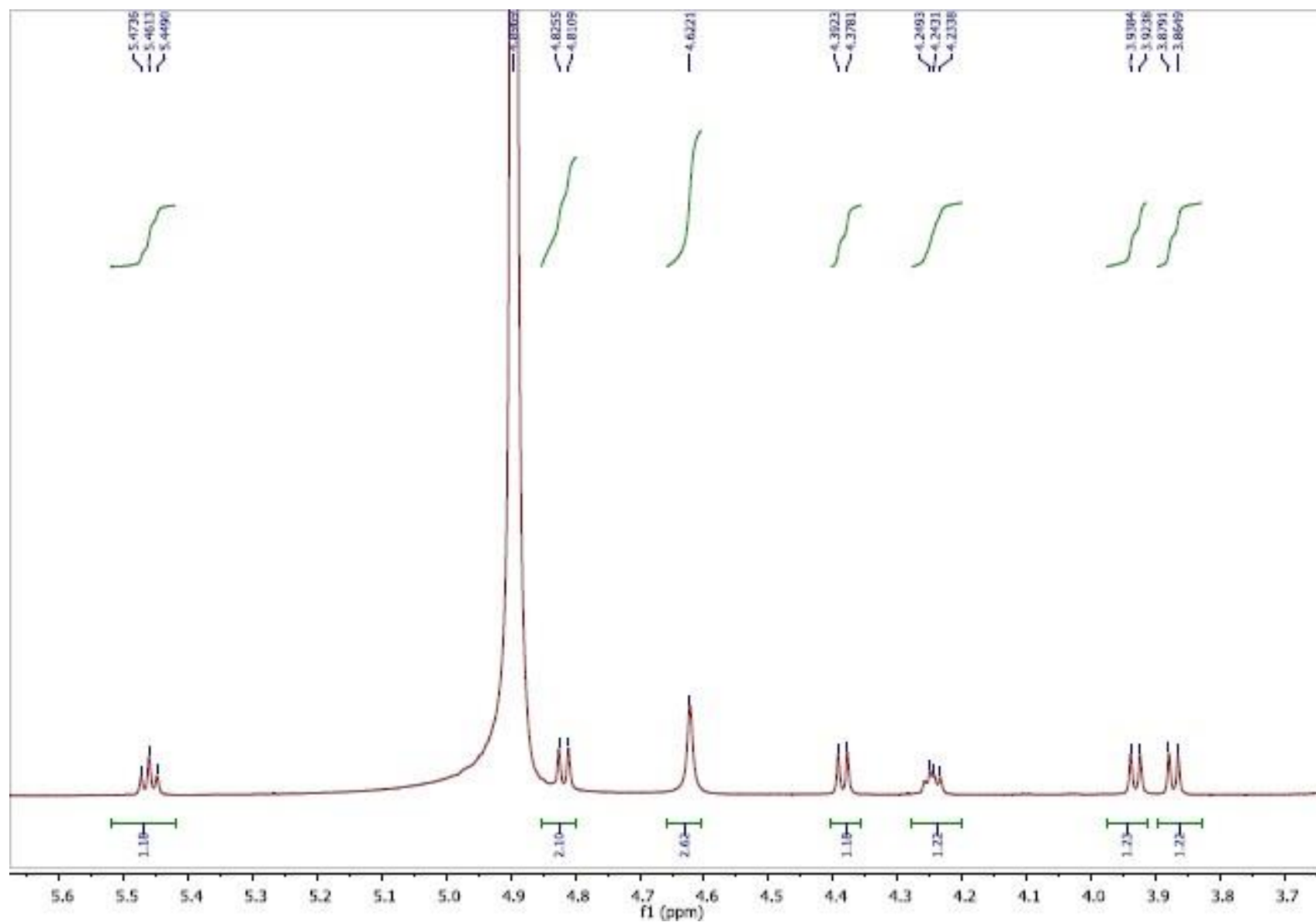
Position	19 ((CD <sub>3</sub> ) <sub>2</sub> SO)		20 ((CD <sub>3</sub> ) <sub>2</sub> SO)	
	$\delta_{\text{H}}$ mult. (J Hz)	$\delta_{\text{C}}$ type	$\delta_{\text{H}}$ mult. (J Hz)	$\delta_{\text{C}}$ type
1	1.50 m, 1.66 dq (4,11)	20.0 CH <sub>2</sub>	1.49 m, 1.65 dq (4,11)	20.0 CH <sub>2</sub>
2	1.24 m, 1.55 m	34.42 CH <sub>2</sub>	1.20 dq (4,11), 1.51 m	34.1 CH <sub>2</sub>
3	3.82 m	64.5 CH	4.10 m	64.7 CH
4	-	69.6 C <sub>q</sub>	-	69.4 C <sub>q</sub>
5	-	45.2 C <sub>q</sub>	-	46.9 C <sub>q</sub>
6	3.63 dd, 12, 3)	72.7 CH	3.55 dd (12, 6)	72.8 CH
7	1.43 m, 1.50 m	34.41 CH <sub>2</sub>	1.45 m, 1.51 m	34.1 CH <sub>2</sub>
8	1.24 m	34.1 CH	1.44 m	34.2 CH
9	-	38.6 C <sub>q</sub>	-	38.5 C <sub>q</sub>
10	1.38 m	46.3 CH	1.25 dd (11, 3)	46.5 CH
11	1.50 m, 1.98 m	34.38 CH <sub>2</sub>	1.45 m, 1.97 m	34.2 CH <sub>2</sub>
12	2.15 ddd (11, 9, 4), 2.25 ddd (11, 9, 3)	21.9 CH <sub>2</sub>	2.12 ddd (11, 9, 4), 2.25 ddd (11, 9, 3)	22.0 CH <sub>2</sub>
13	-	174.4 C <sub>q</sub>	-	174.4 C <sub>q</sub>
14	5.96 br	114.0 CH	5.95 s	113.9 CH
15	-	173.4 C <sub>q</sub>	-	173.5 C <sub>q</sub>
16	4.86 s	73.5 CH <sub>2</sub>	4.86 s	73.5 CH <sub>2</sub>
17	0.78 d (7)	15.8 CH <sub>3</sub>	0.77 d (7)	15.9 CH <sub>3</sub>
18	2.84 d (4), 3.09 d (4)	43.0 CH <sub>2</sub>	2.70 d (4), 2.89 d (4)	40.5 CH <sub>2</sub>
19	4.34 d (11), 4.49 d (11)	62.4 CH <sub>2</sub>	3.78 dd (11, 9), 3.98 dd (11, 3)	60.3 CH <sub>2</sub>
20	0.65 s	17.6 CH <sub>3</sub>	0.62 s	17.7 CH <sub>3</sub>
MeCO <sub>2</sub> -19	2.02 s	21.5 CH <sub>3</sub>		
MeCO <sub>2</sub> -19	-	170.8 C <sub>q</sub>		
HO-3	4.76 d (5)	-	4.56 d (4)	-
HO-6	nd	-	3.82 m	-
HO-19	-	-	4.12 dd (9, 3)	-



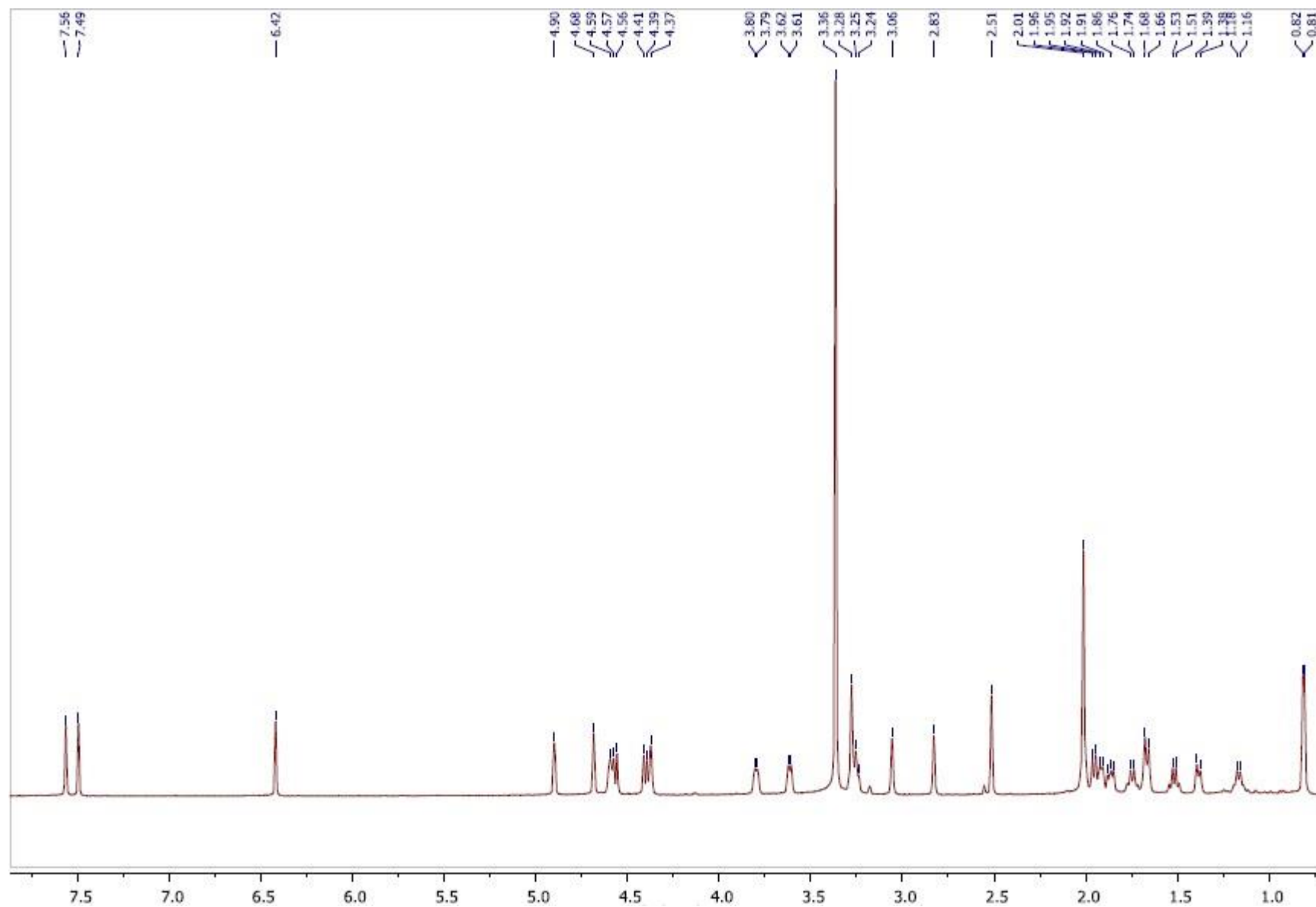
**Figure S1.** <sup>1</sup>H NMR spectrum of **1** in CD<sub>3</sub>OD.



**Figure S2.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  1.0 –  $\delta$  2.7) of **1** in  $\text{CD}_3\text{OD}$ .

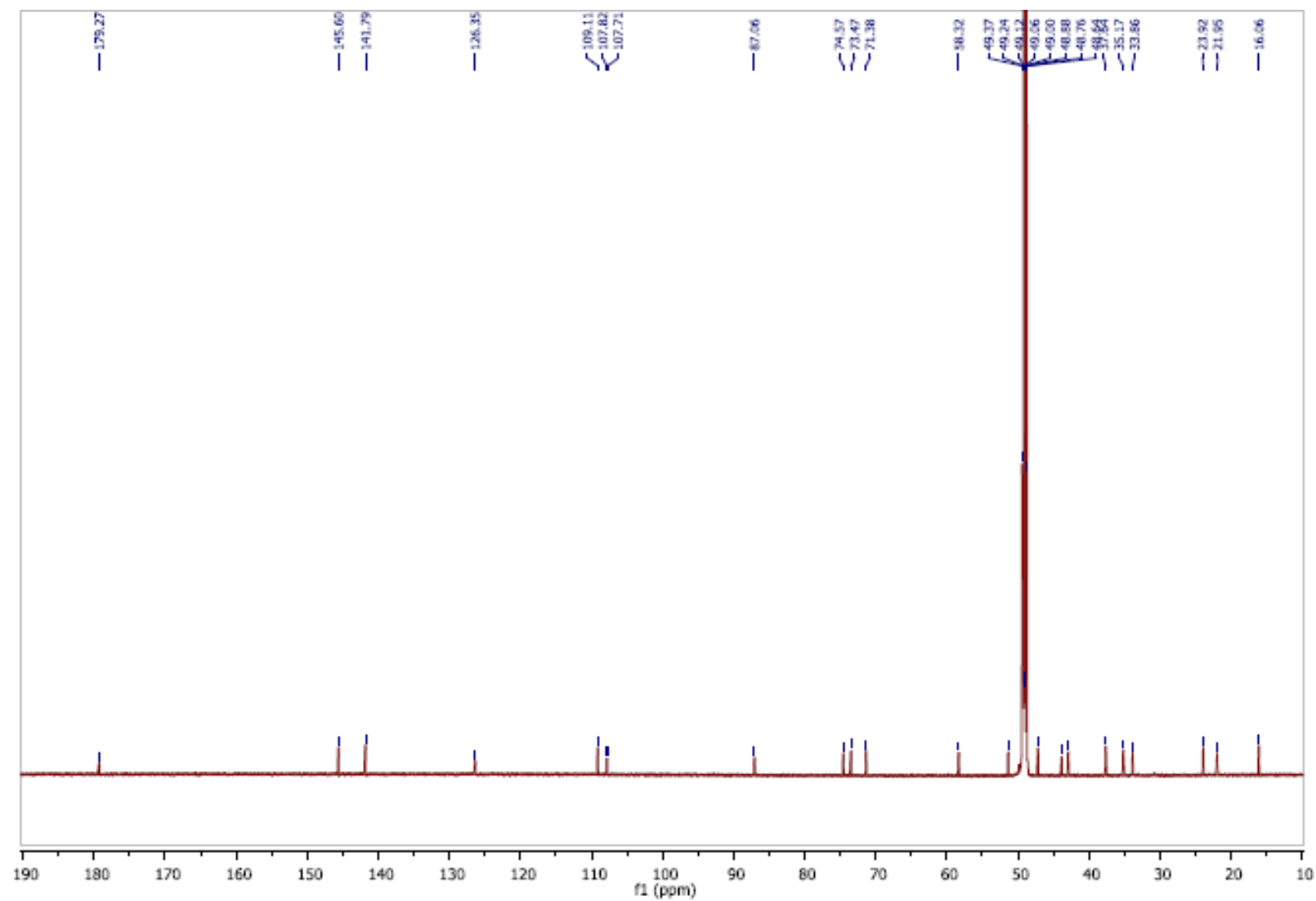


**Figure S3.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  3.7 –  $\delta$  5.6) of **1** in  $\text{CD}_3\text{OD}$ .

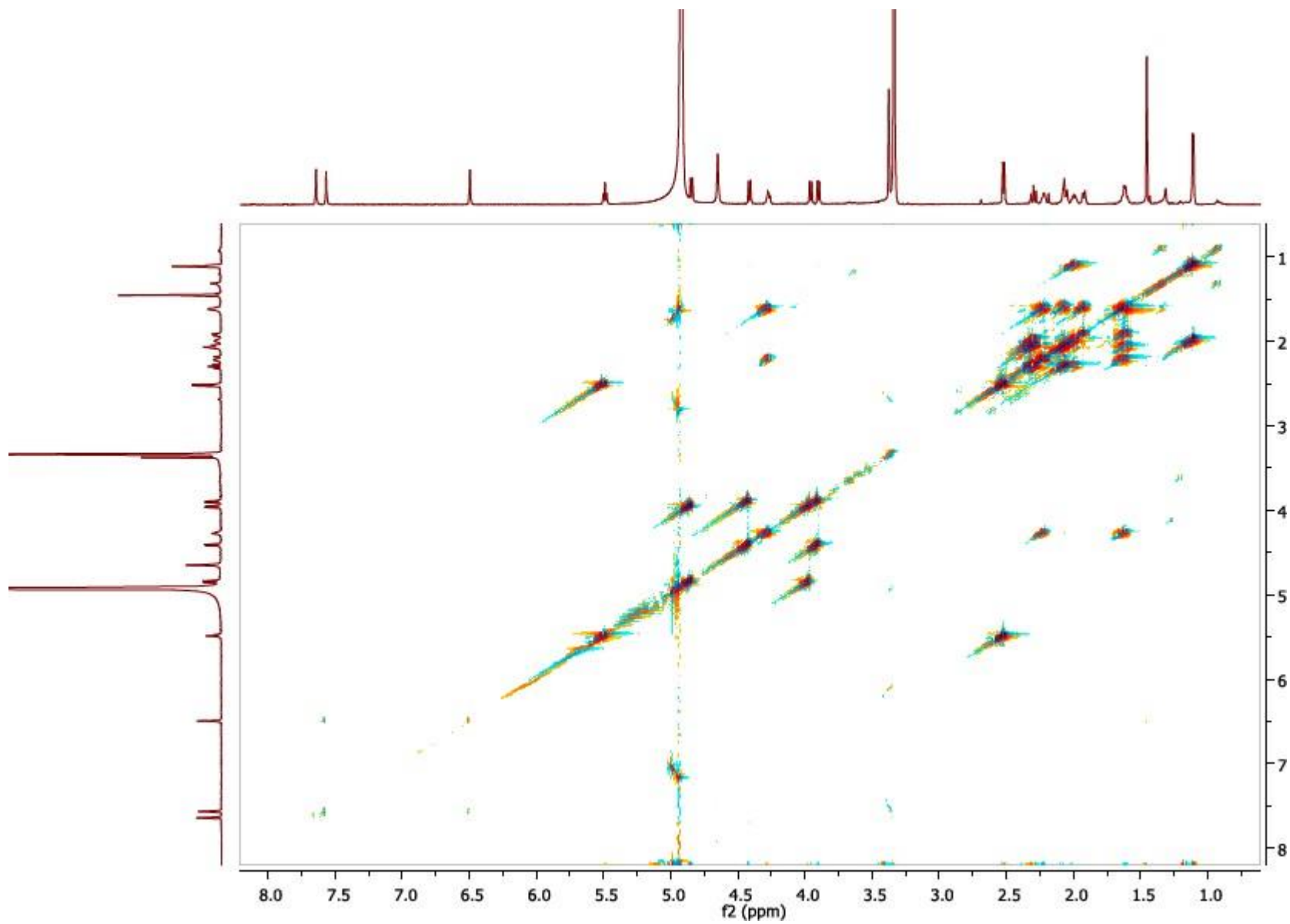


**Figure S4.** <sup>1</sup>H NMR spectrum of **1** in (CD<sub>3</sub>)<sub>2</sub>SO.

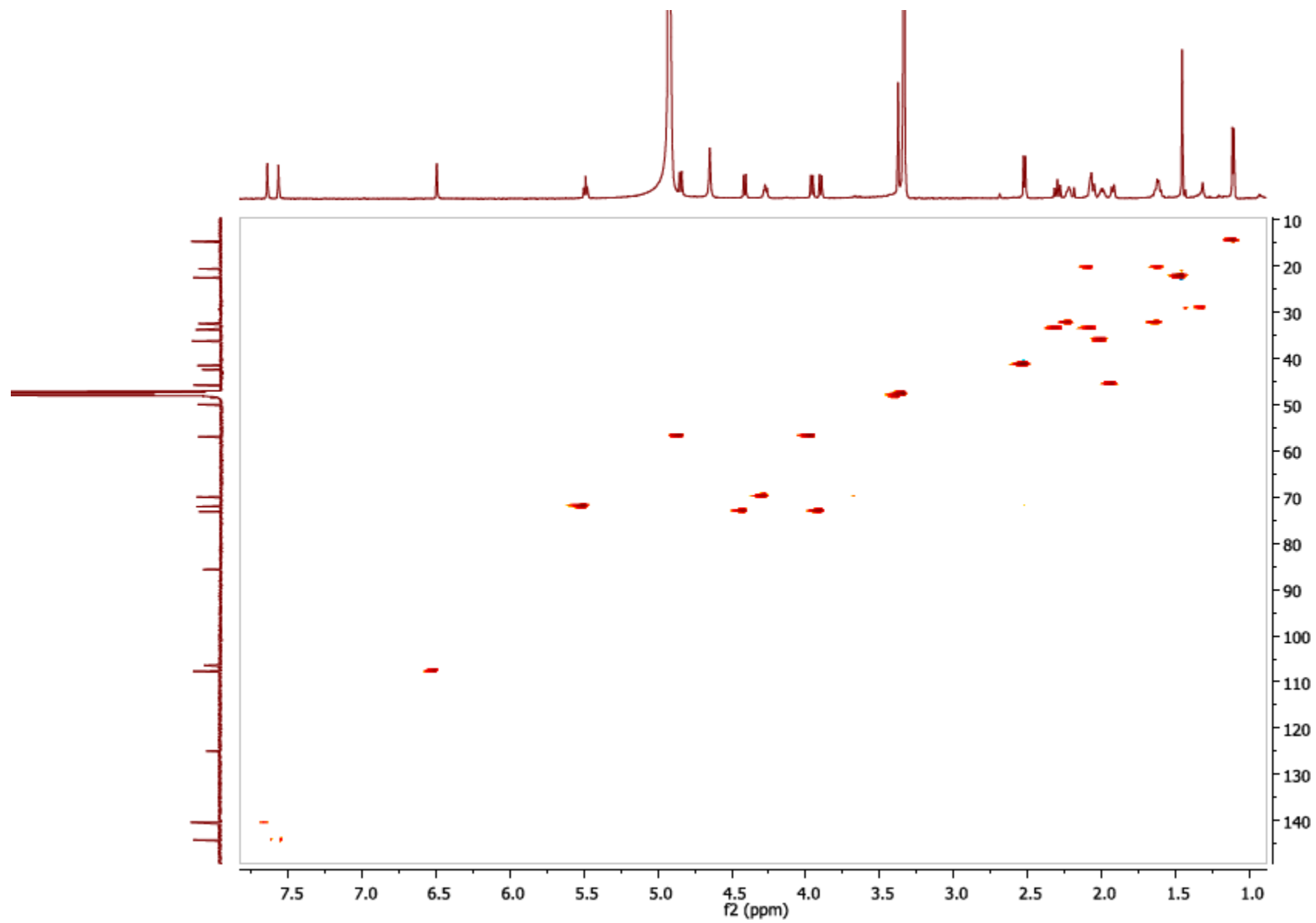




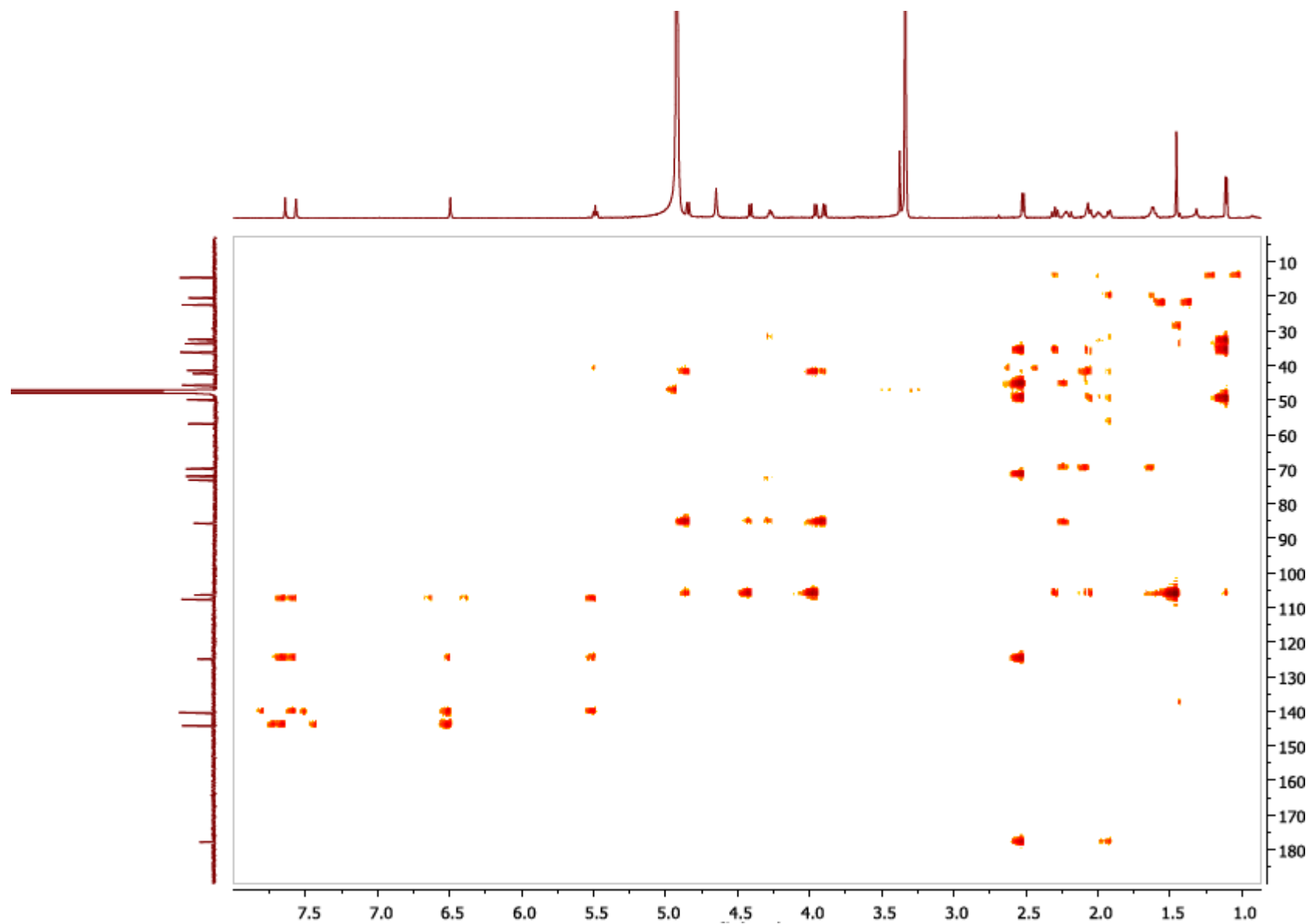
**Figure S5.**  $^{13}\text{C}$  NMR spectrum of **1** in  $\text{CD}_3\text{OD}$ .



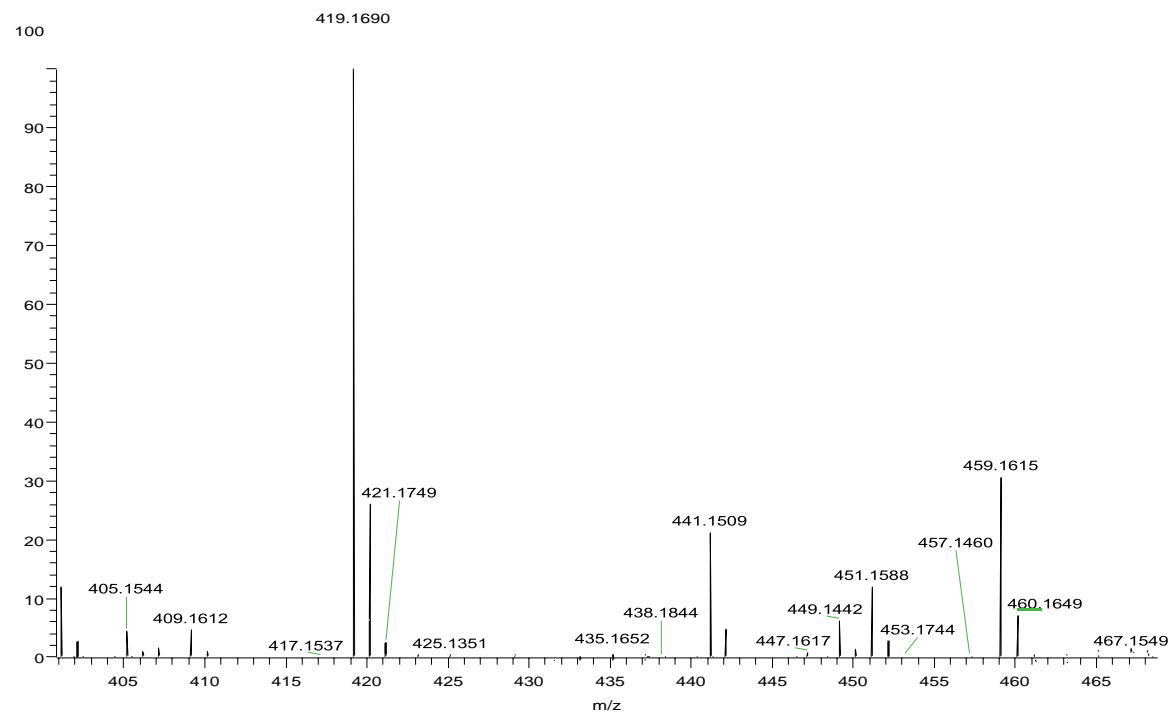
**Figure S6.** COSY NMR spectrum of **1** in CD<sub>3</sub>OD.



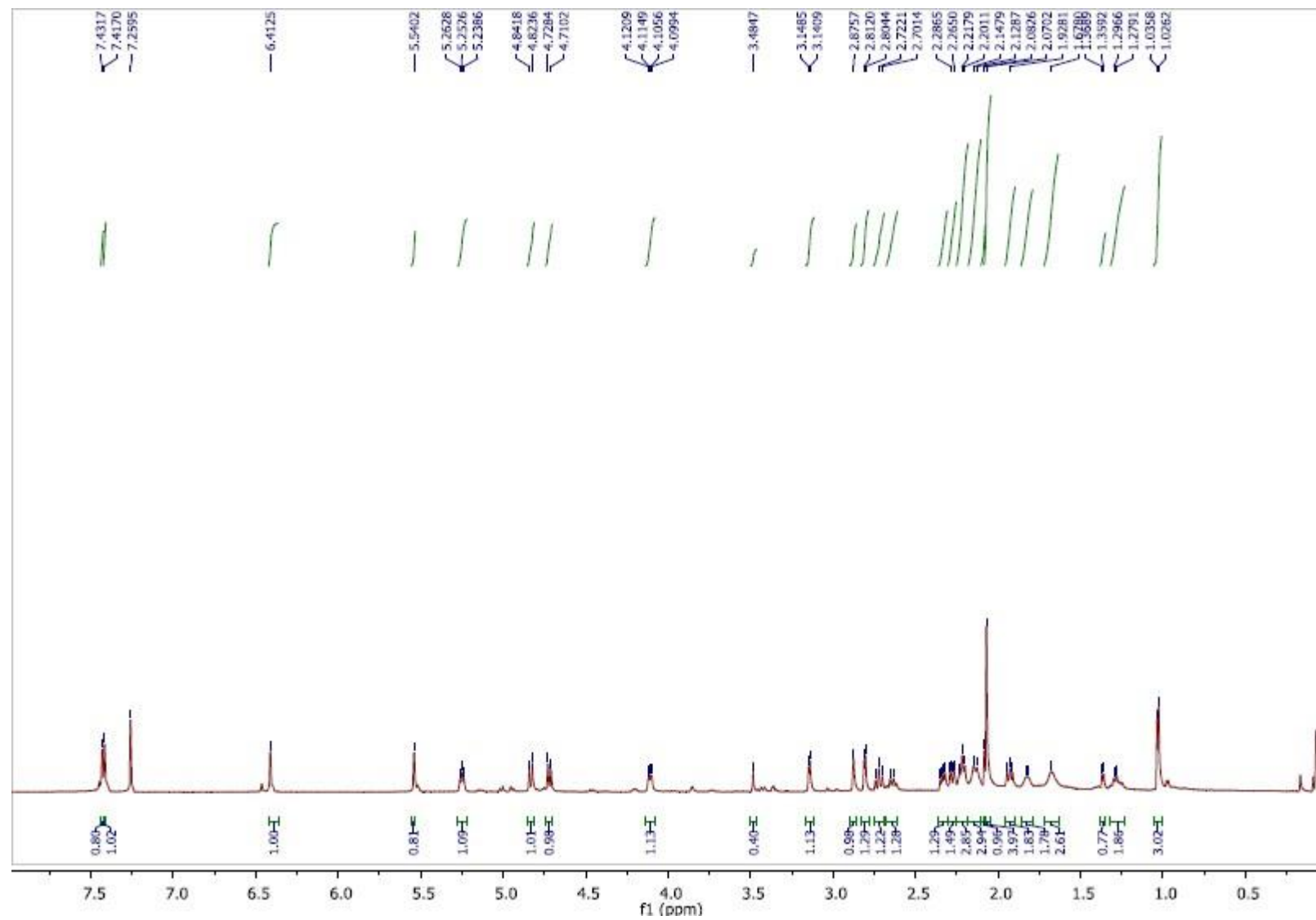
**Figure S7.** HSQC NMR spectrum of **1** in CD<sub>3</sub>OD.



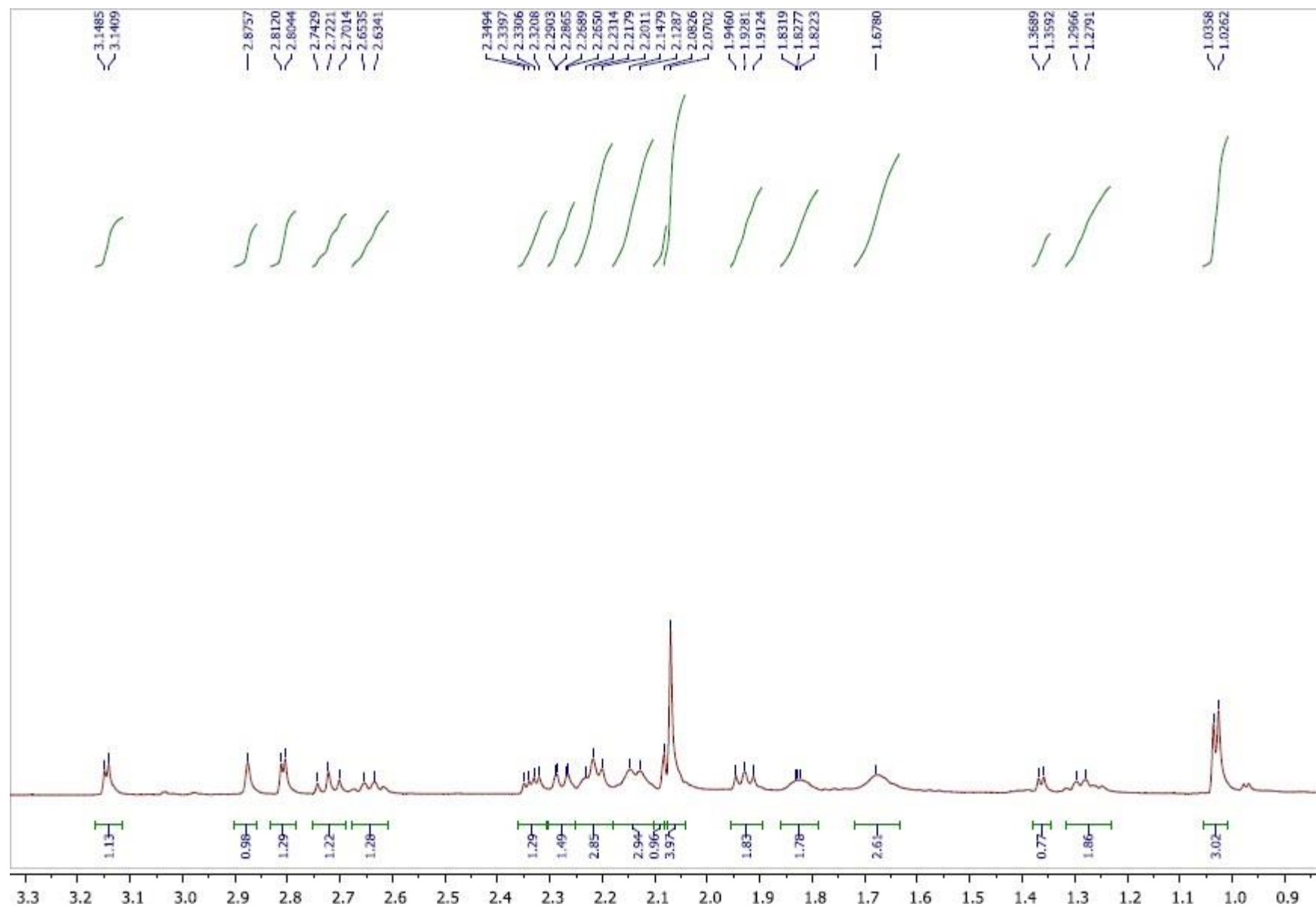
**Figure S8.** HMBC NMR spectrum of **1** in CD<sub>3</sub>OD.



**Figure S9.** Positive-ion HRESIMS of **1**.

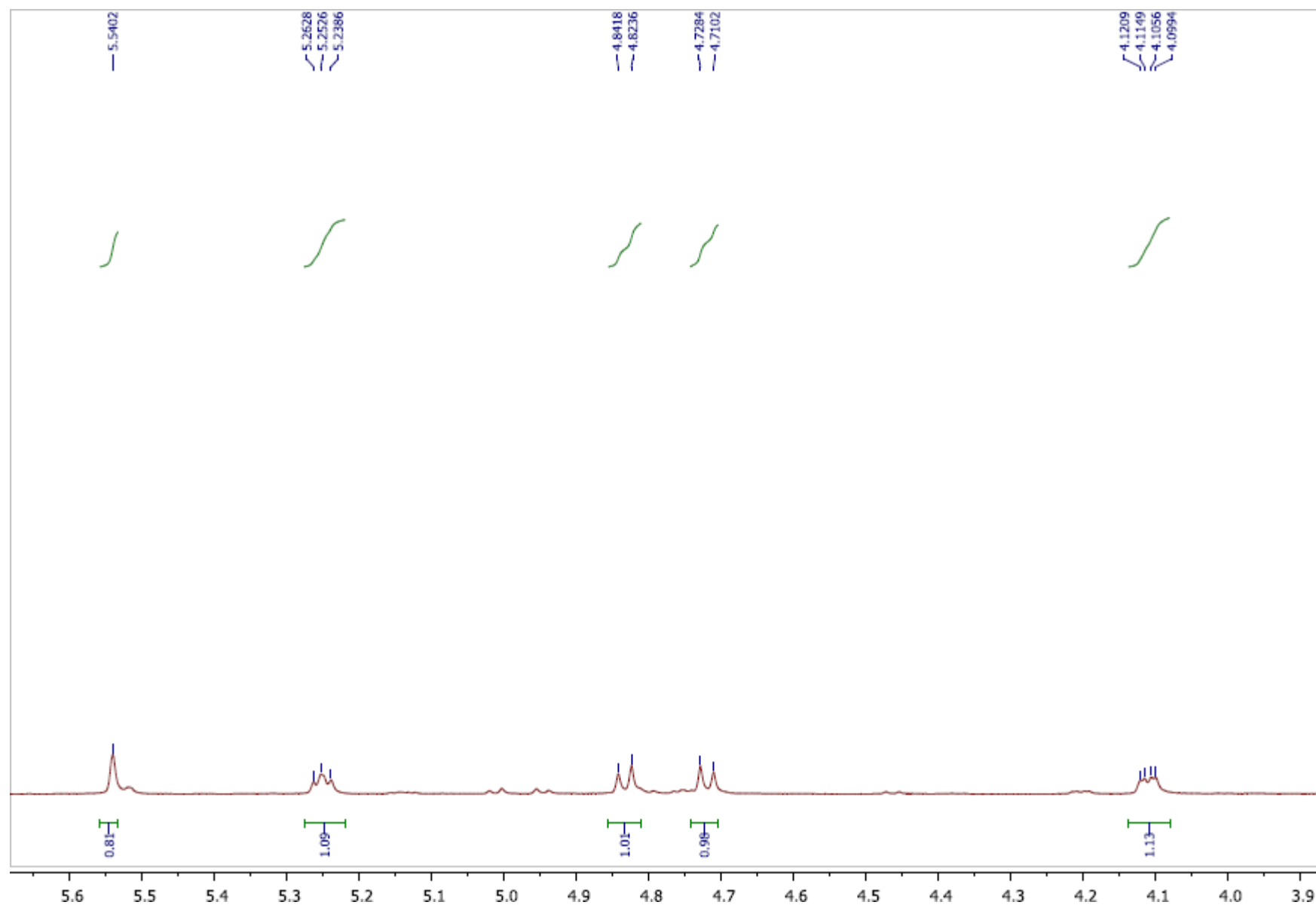


**Figure S10.** <sup>1</sup>H NMR spectrum of **2** in CD<sub>3</sub>OD.

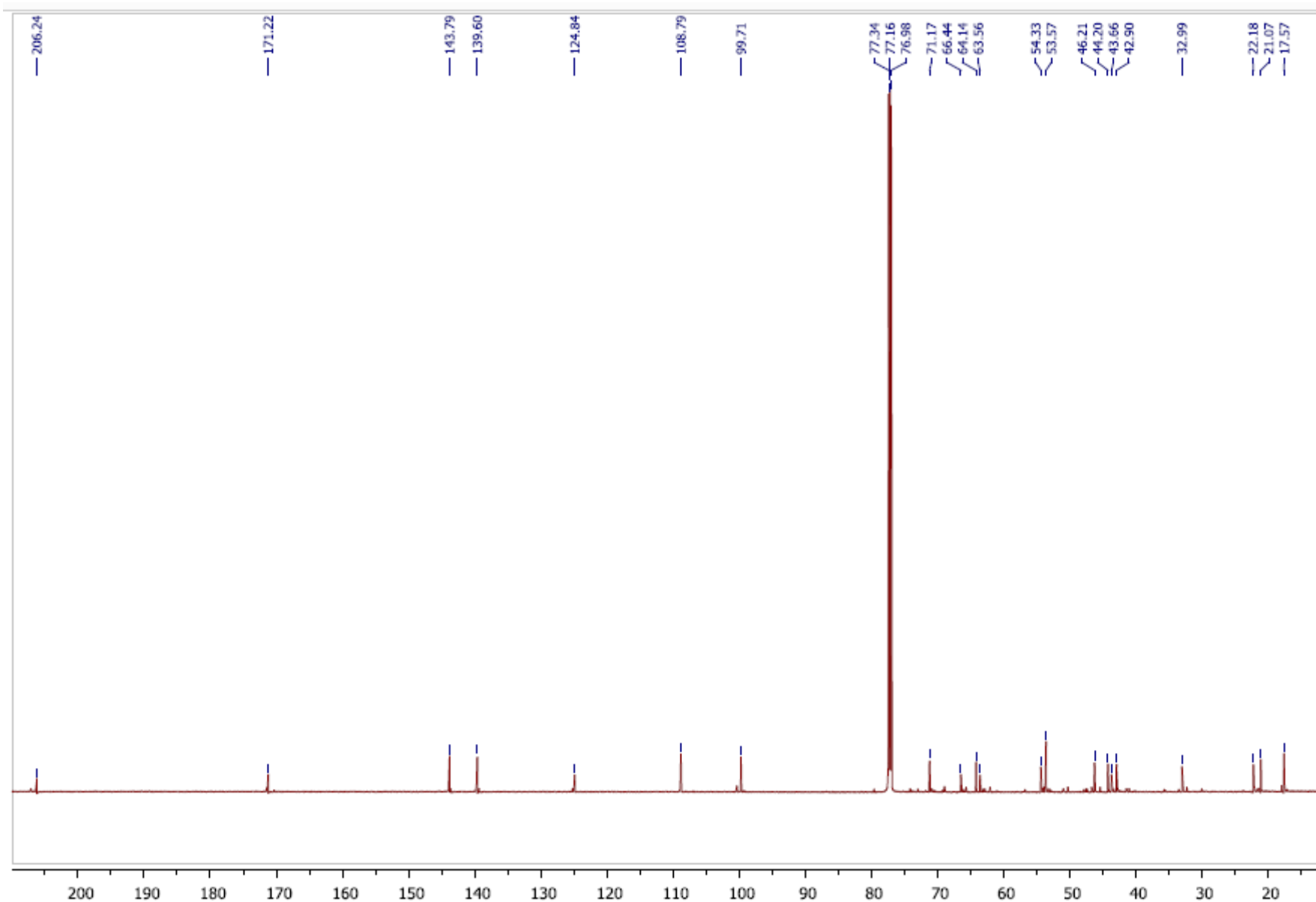


**Figure S11.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.9 –  $\delta$  3.3) of **2** in  $\text{CD}_3\text{OD}$ .

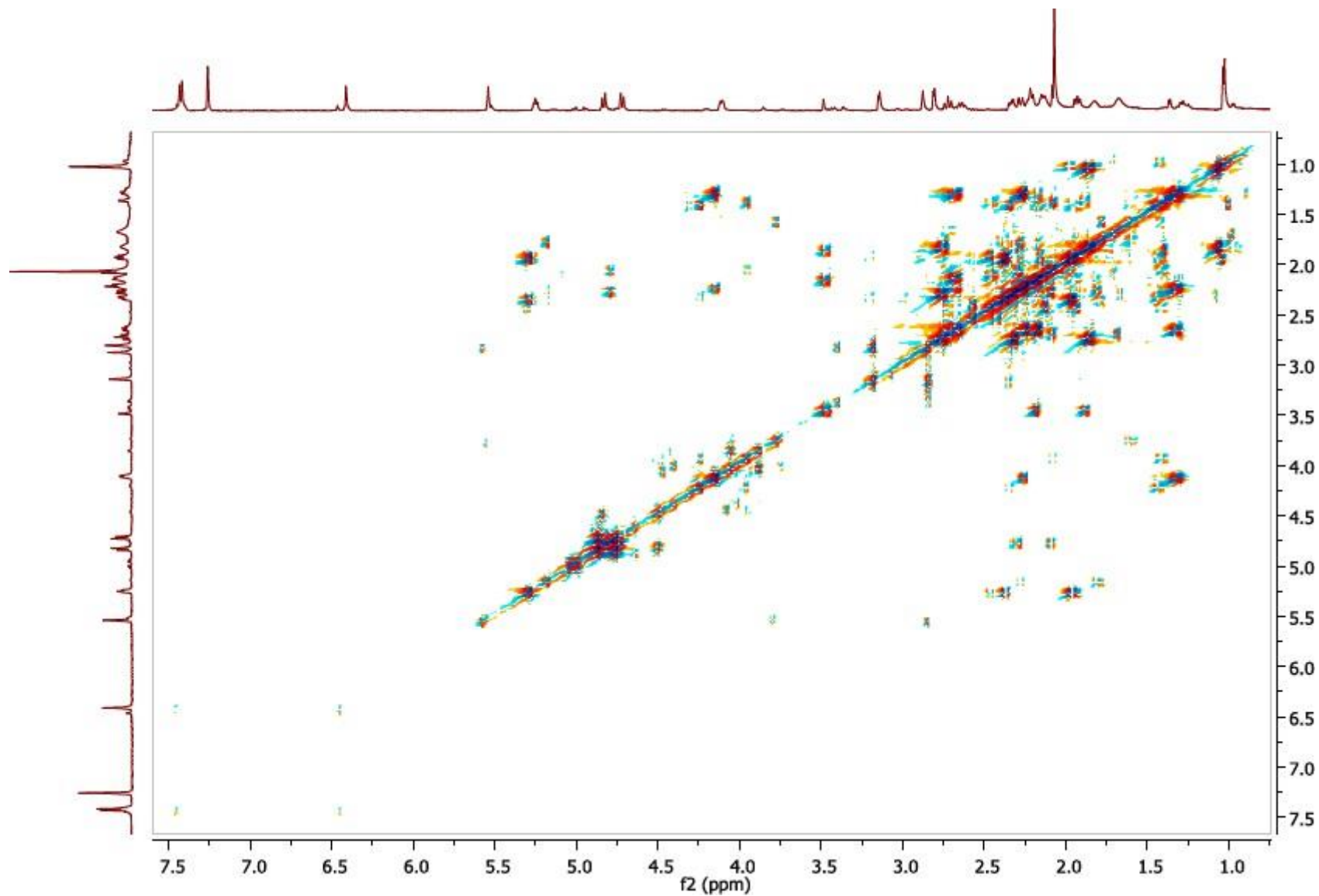




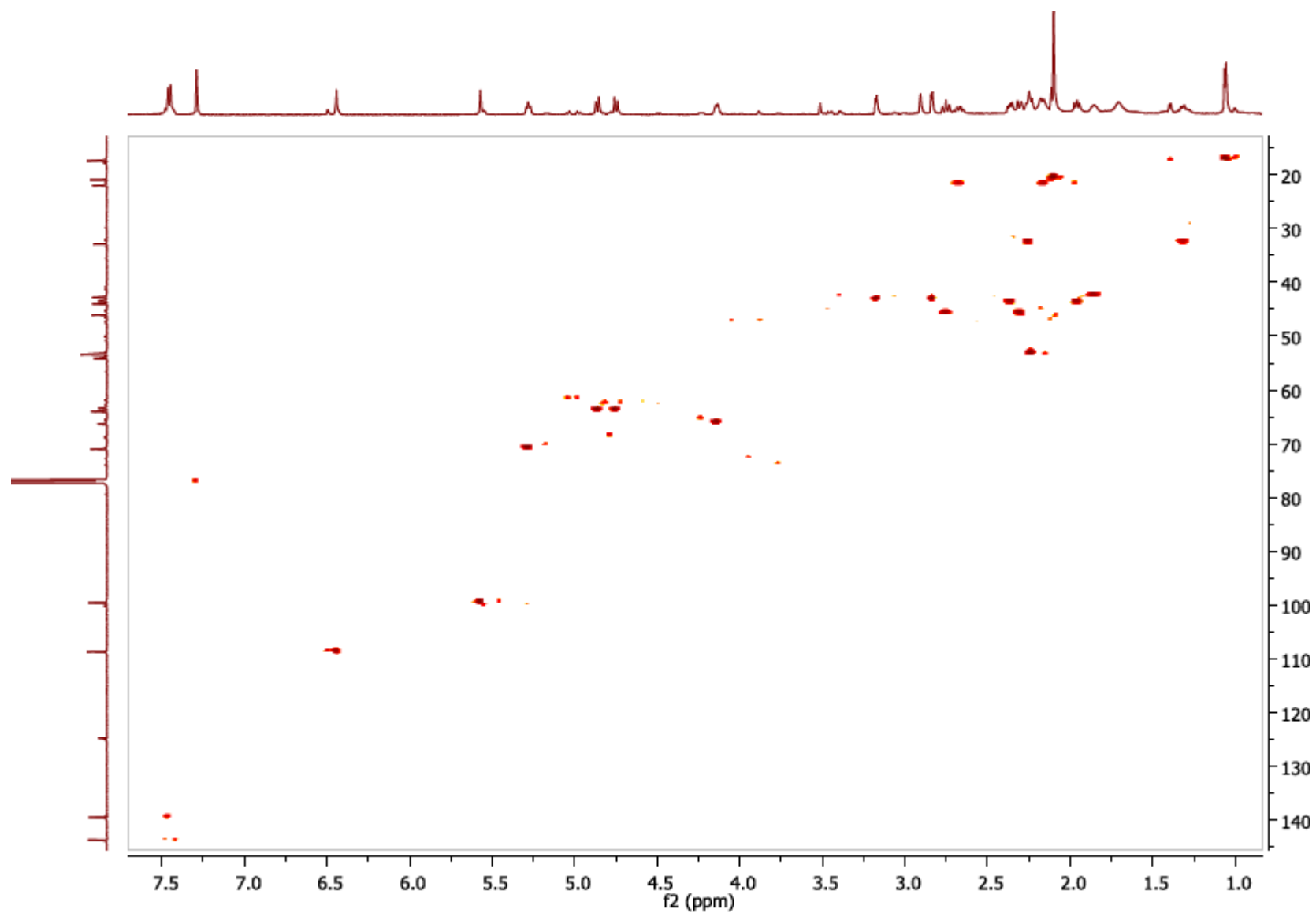
**Figure S12.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  3.9 –  $\delta$  5.6) of **2** in  $\text{CD}_3\text{OD}$ .



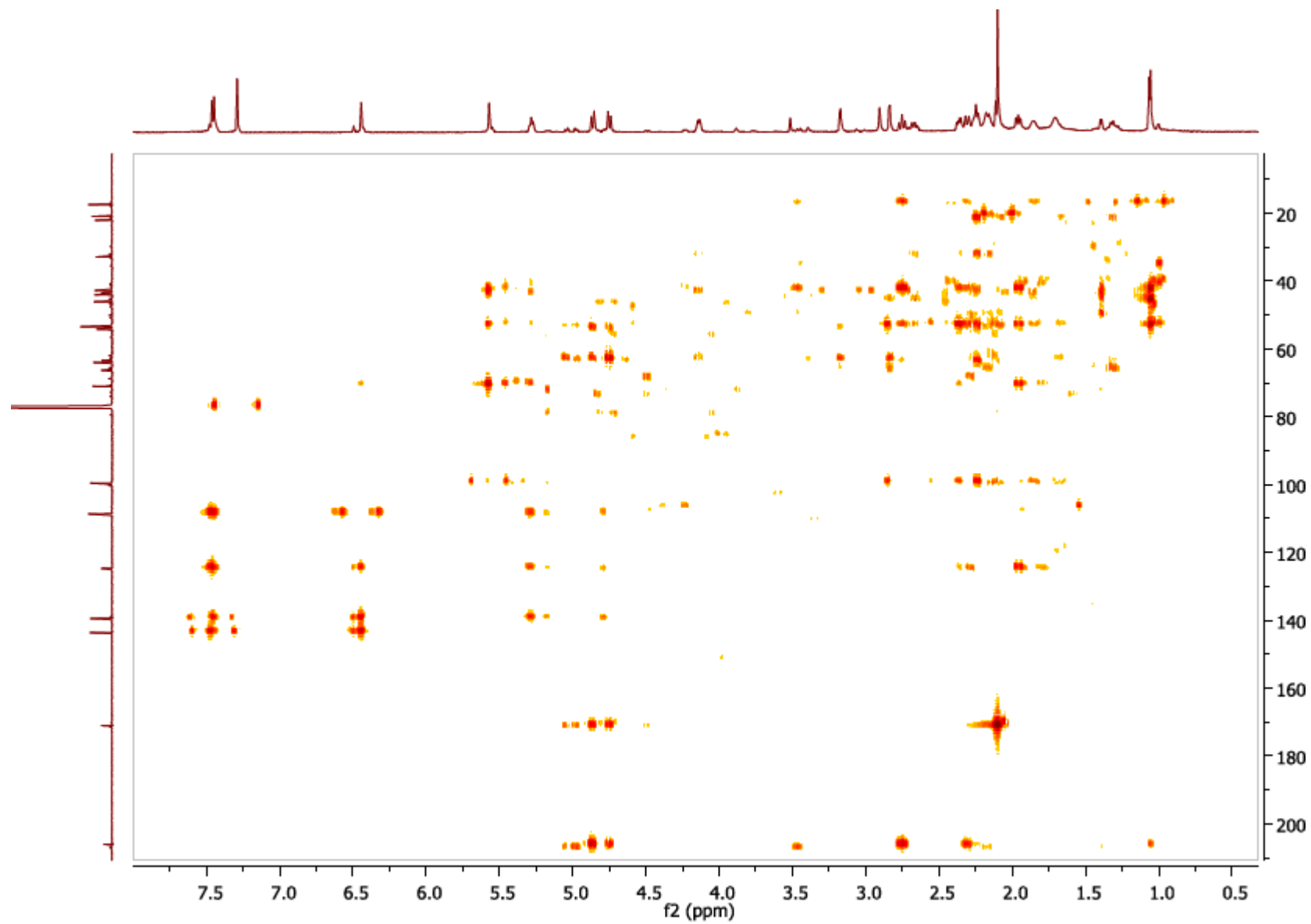
**Figure S13.** <sup>13</sup>C NMR spectrum of **2** in CD<sub>3</sub>OD.



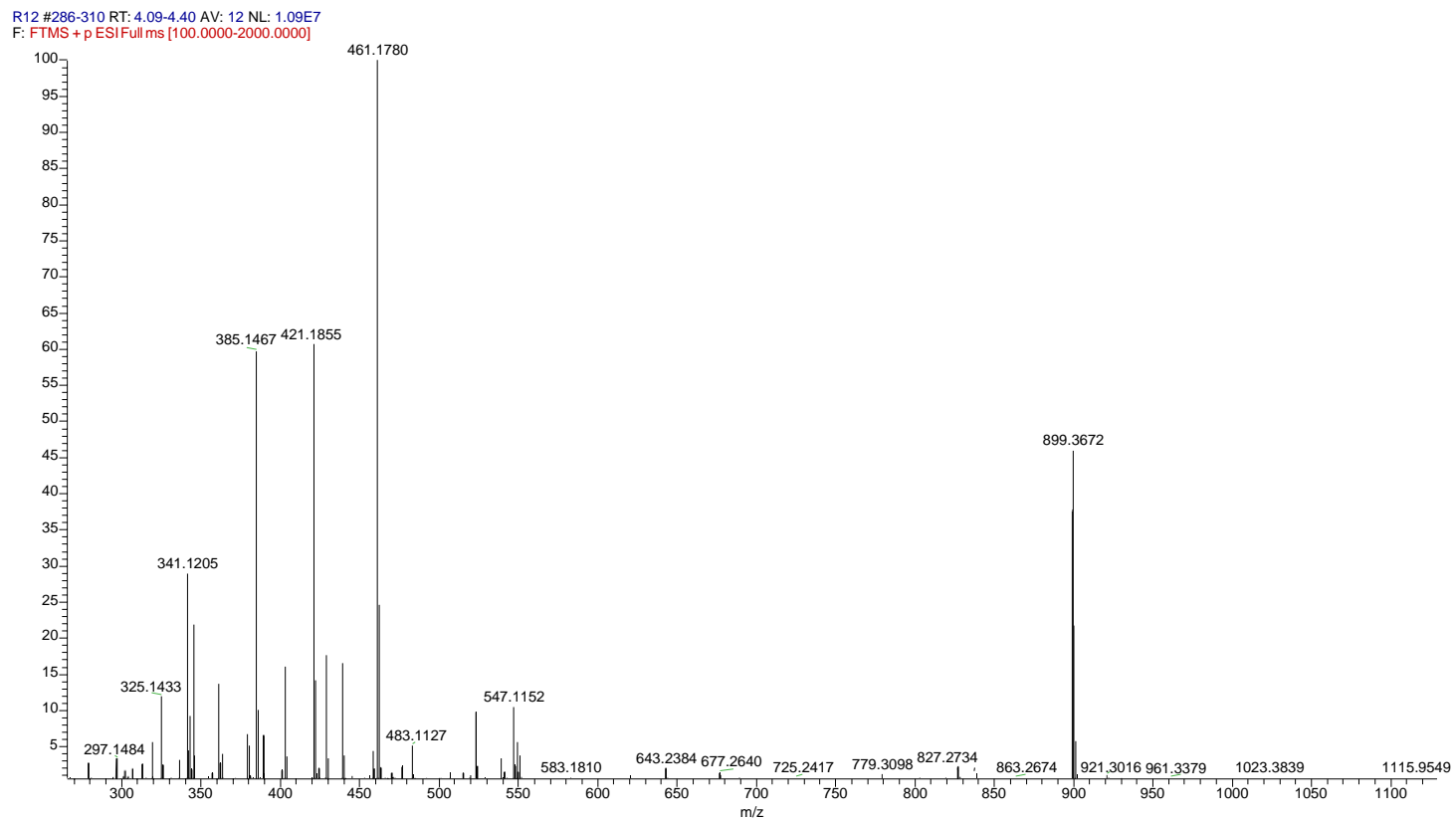
**Figure S14.** COSY NMR spectrum of **2** in CD<sub>3</sub>OD.



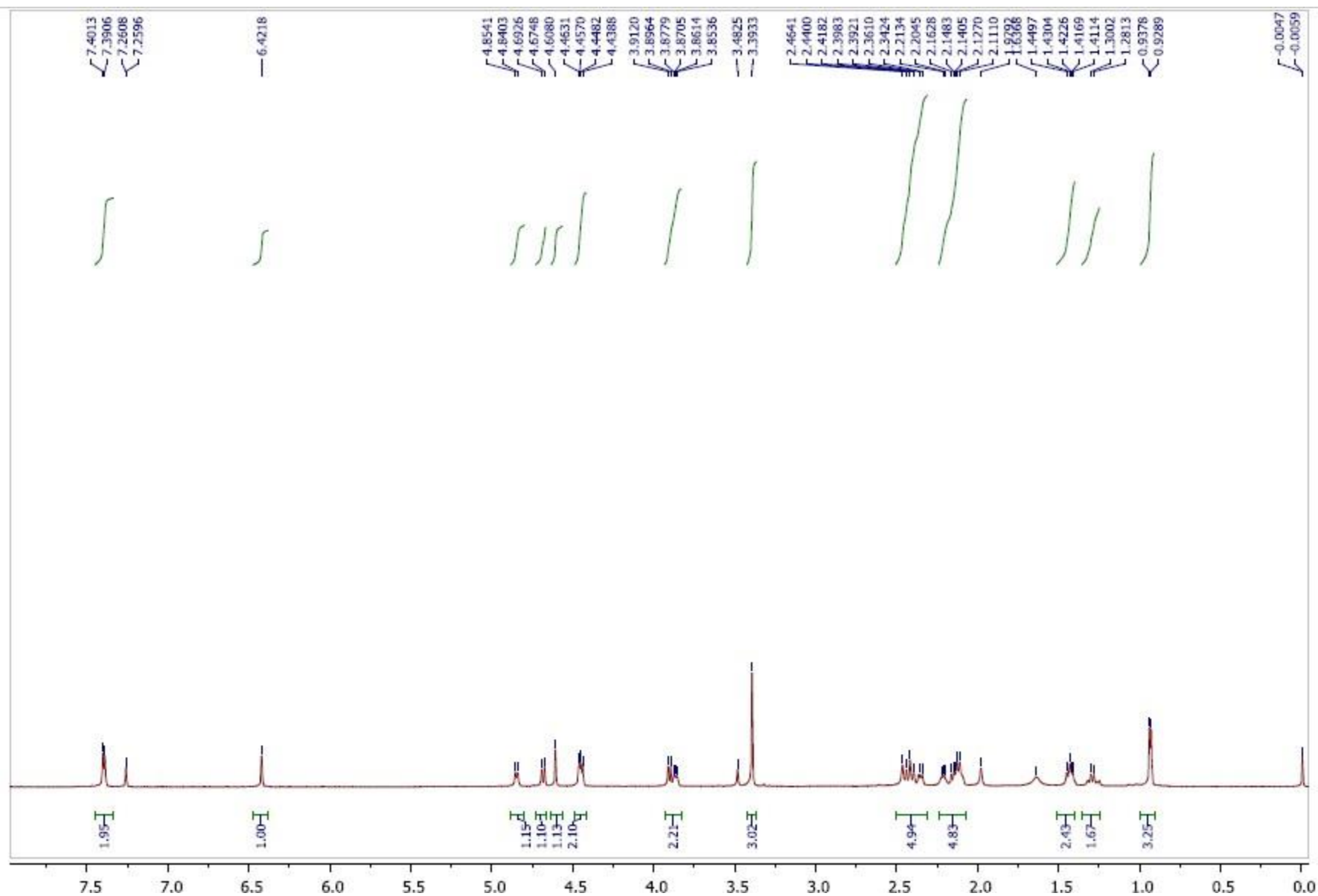
**Figure S15.** HSQC NMR spectrum of **2** in CD<sub>3</sub>OD.



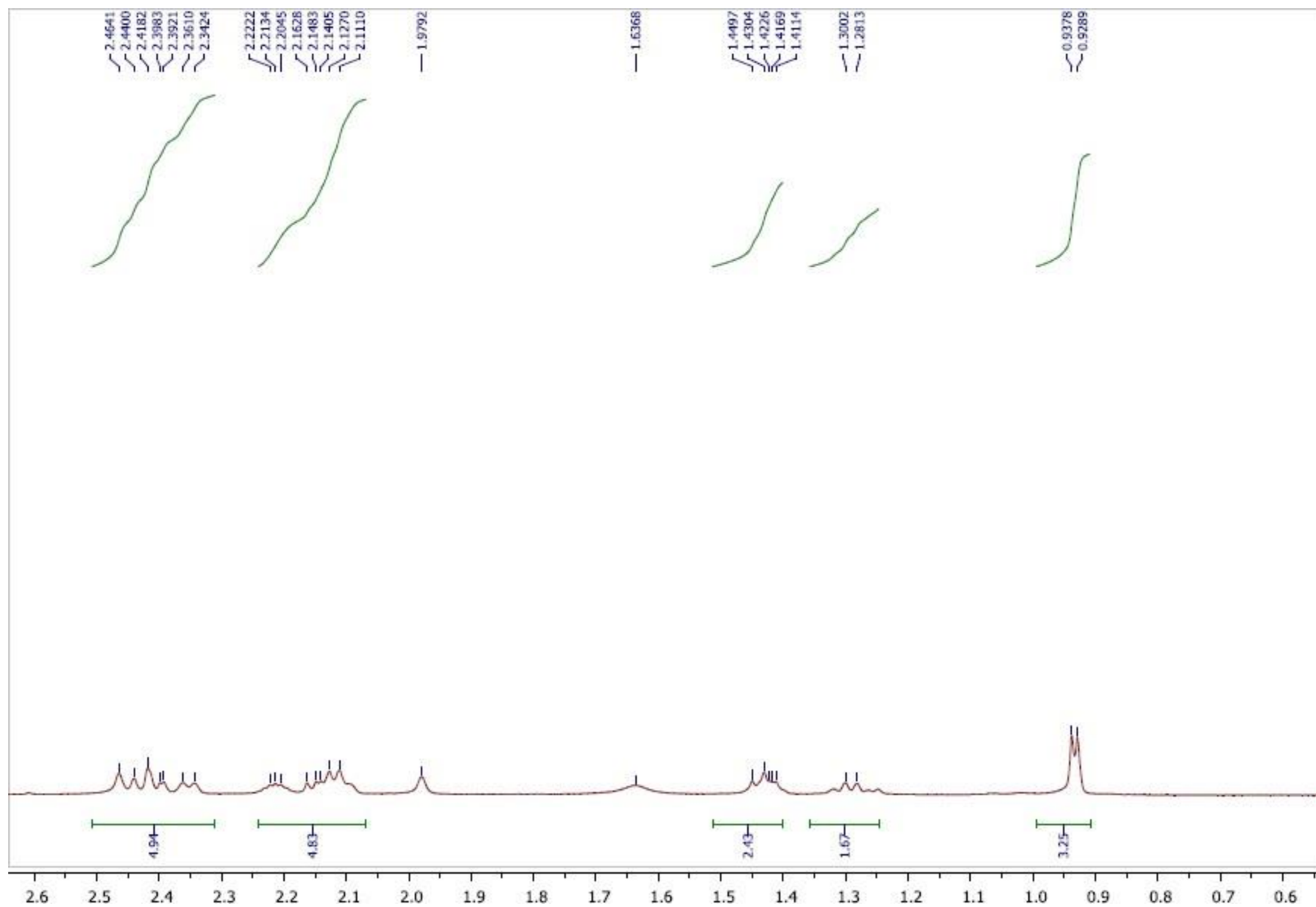
**Figure S16.** HMBC NMR spectrum of **2** in CD<sub>3</sub>OD.



**Figure S17.** Positive-ion HRESIMS of **2**.

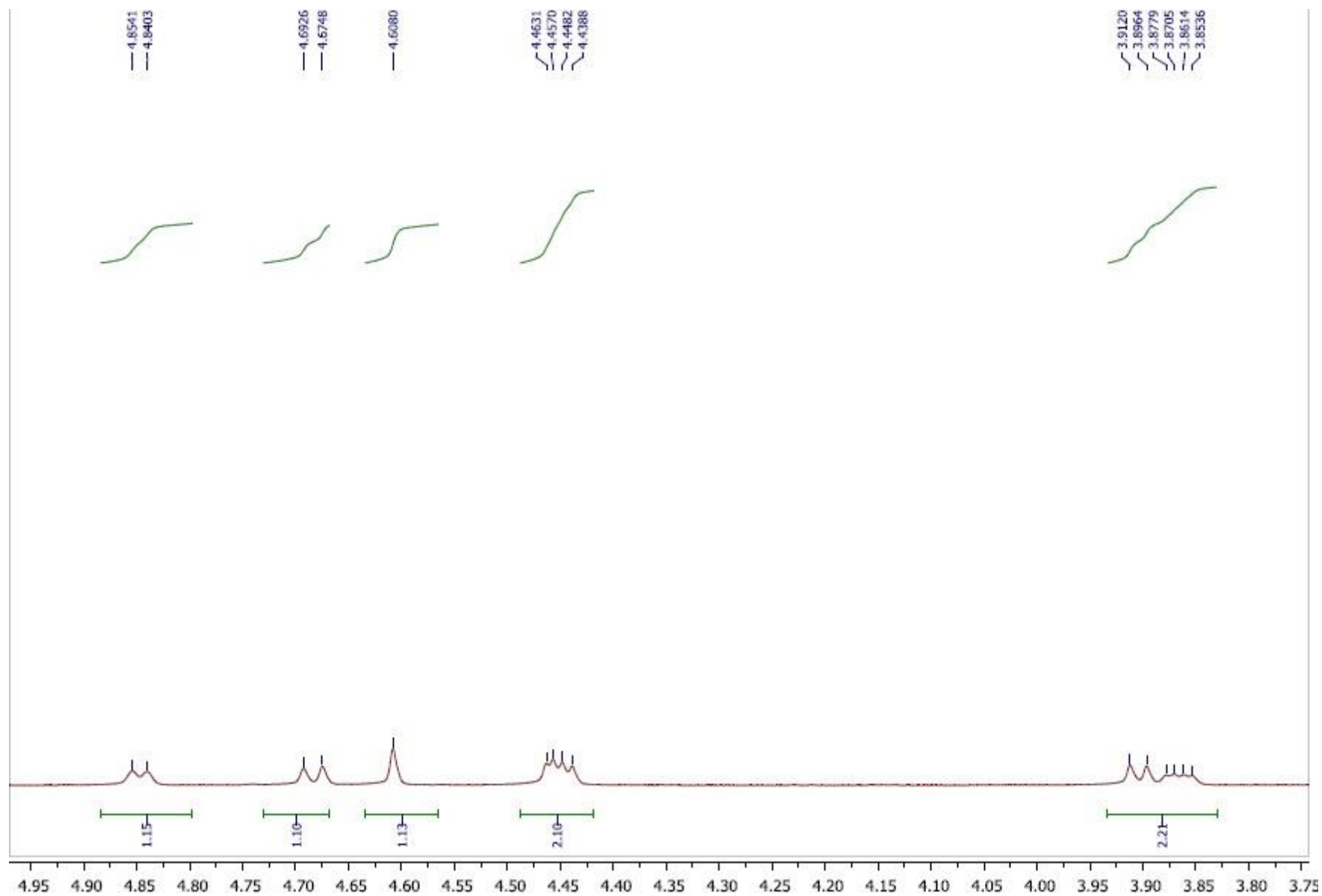


**Figure S18.** <sup>1</sup>H NMR spectrum of **3** in CD<sub>3</sub>OD.

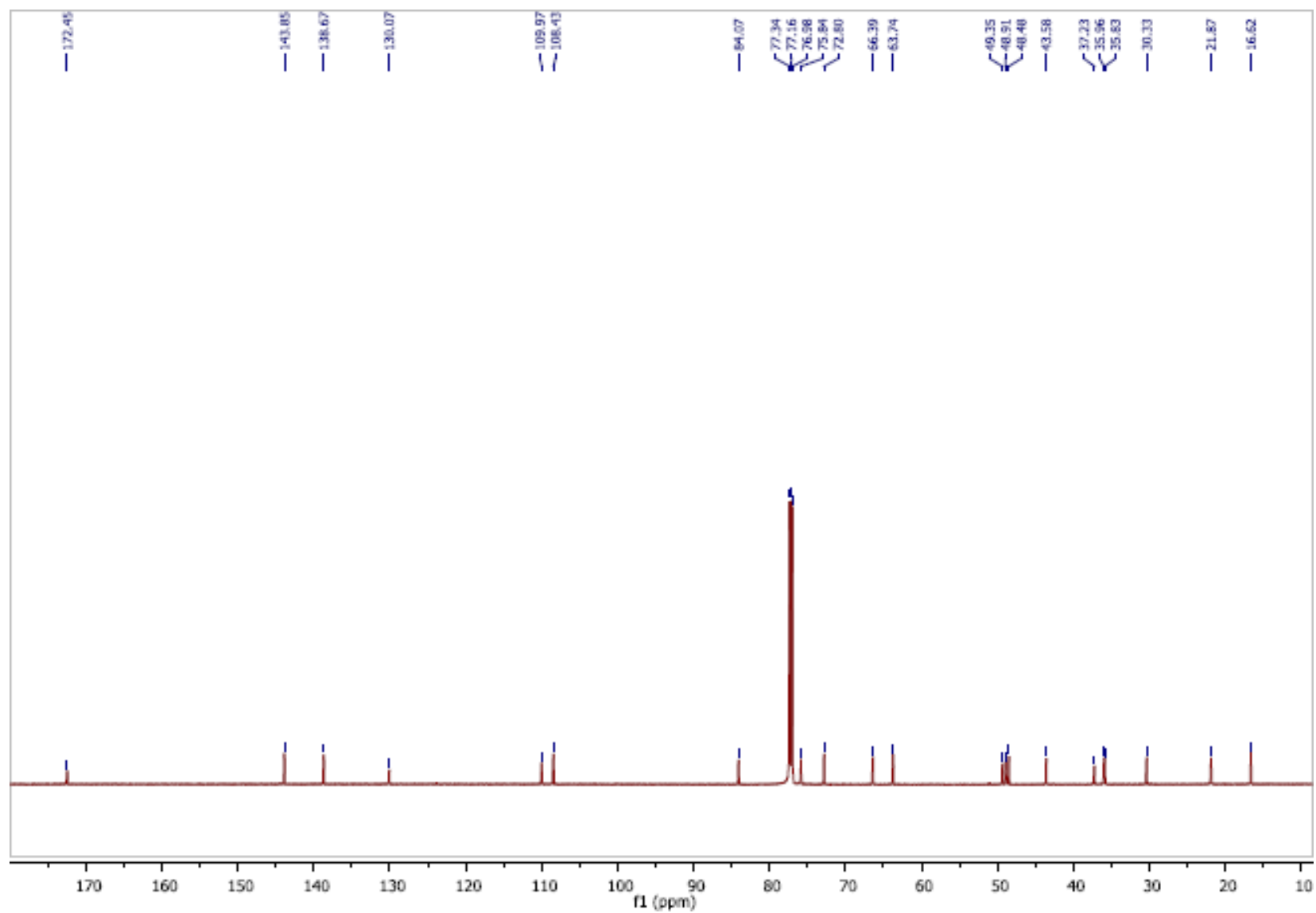


**Figure S19.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.6 –  $\delta$  2.6) of **3** in  $\text{CD}_3\text{OD}$ .

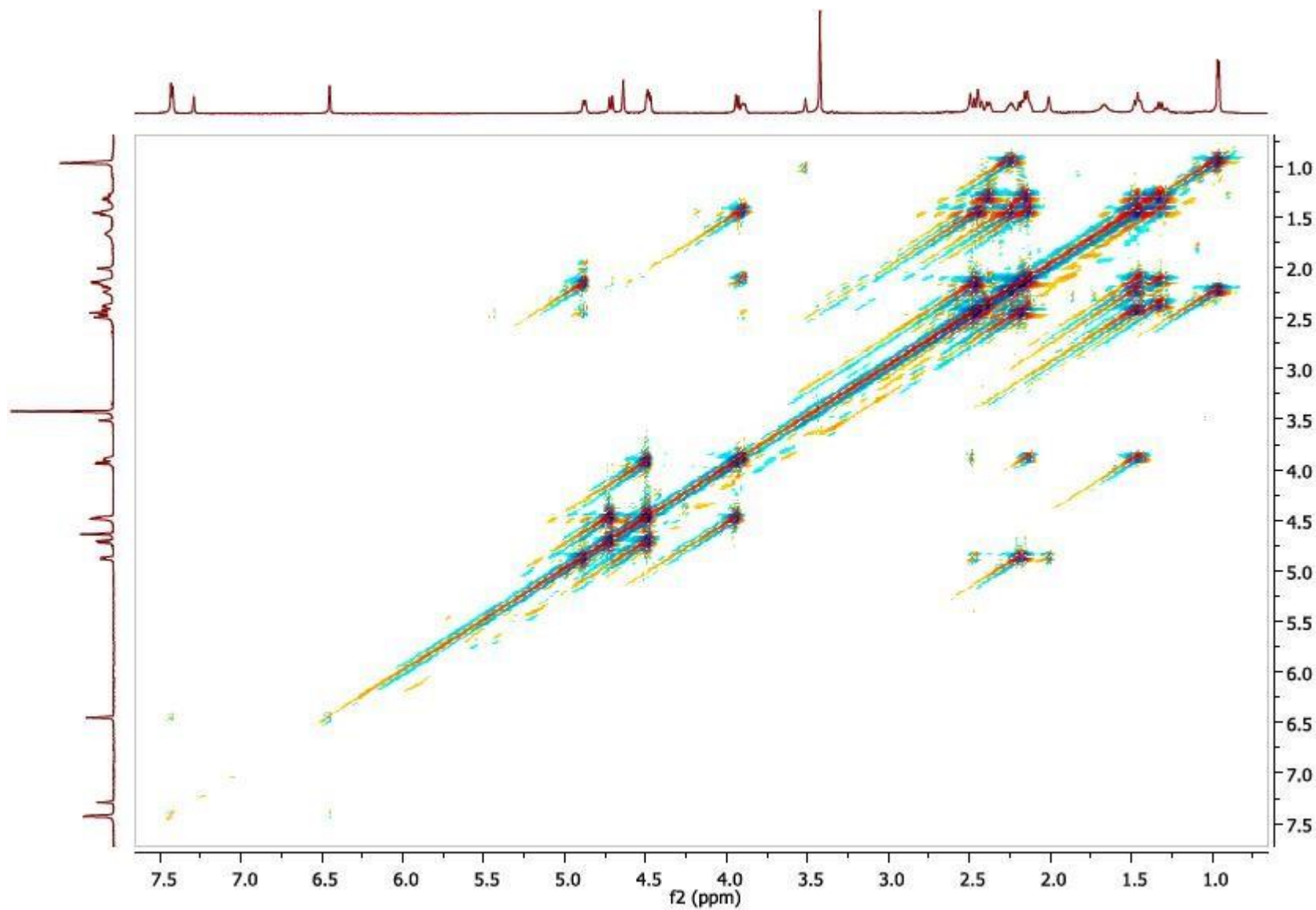




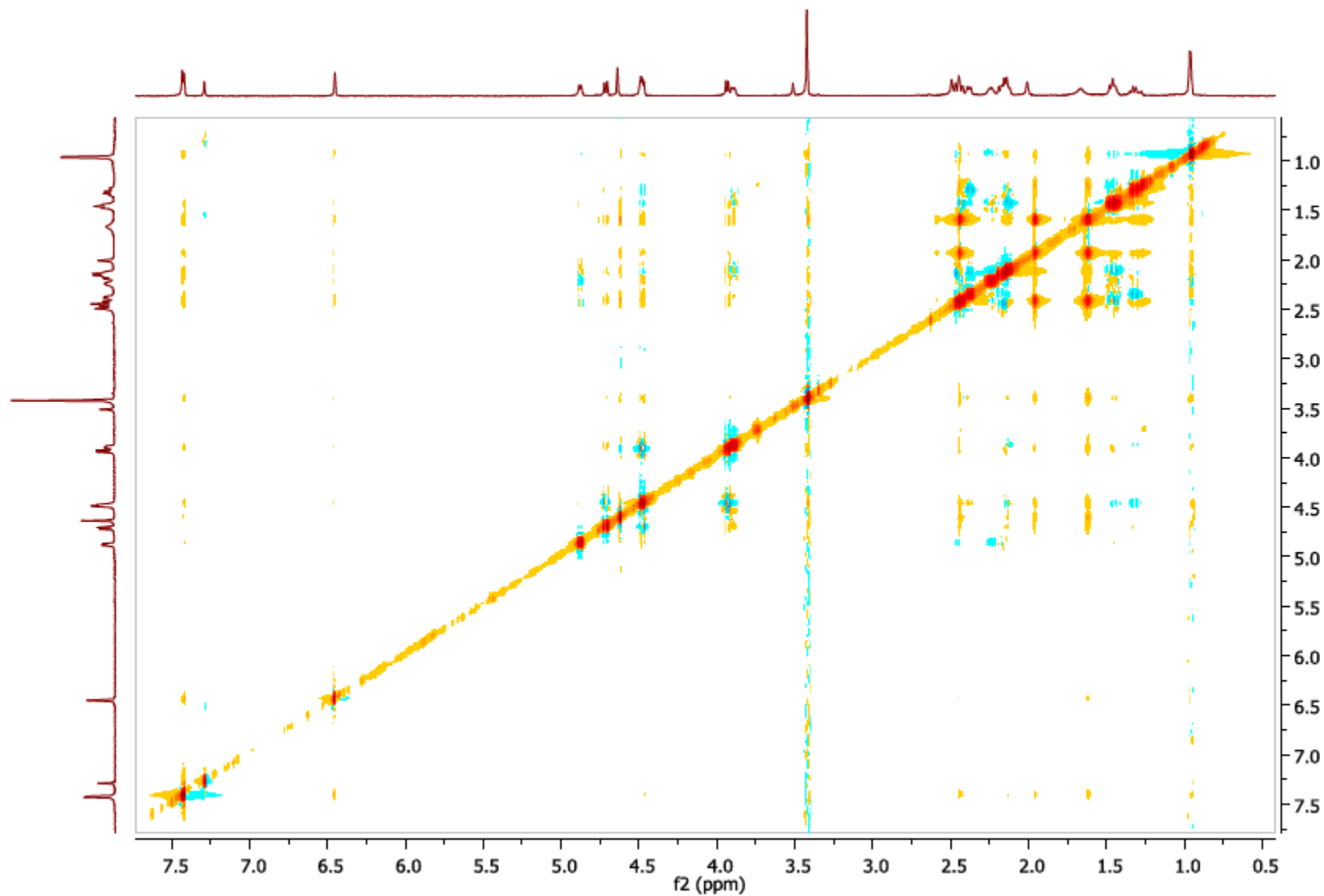
**Figure S20.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  3.75 –  $\delta$  4.95) of **3** in  $\text{CD}_3\text{OD}$ .



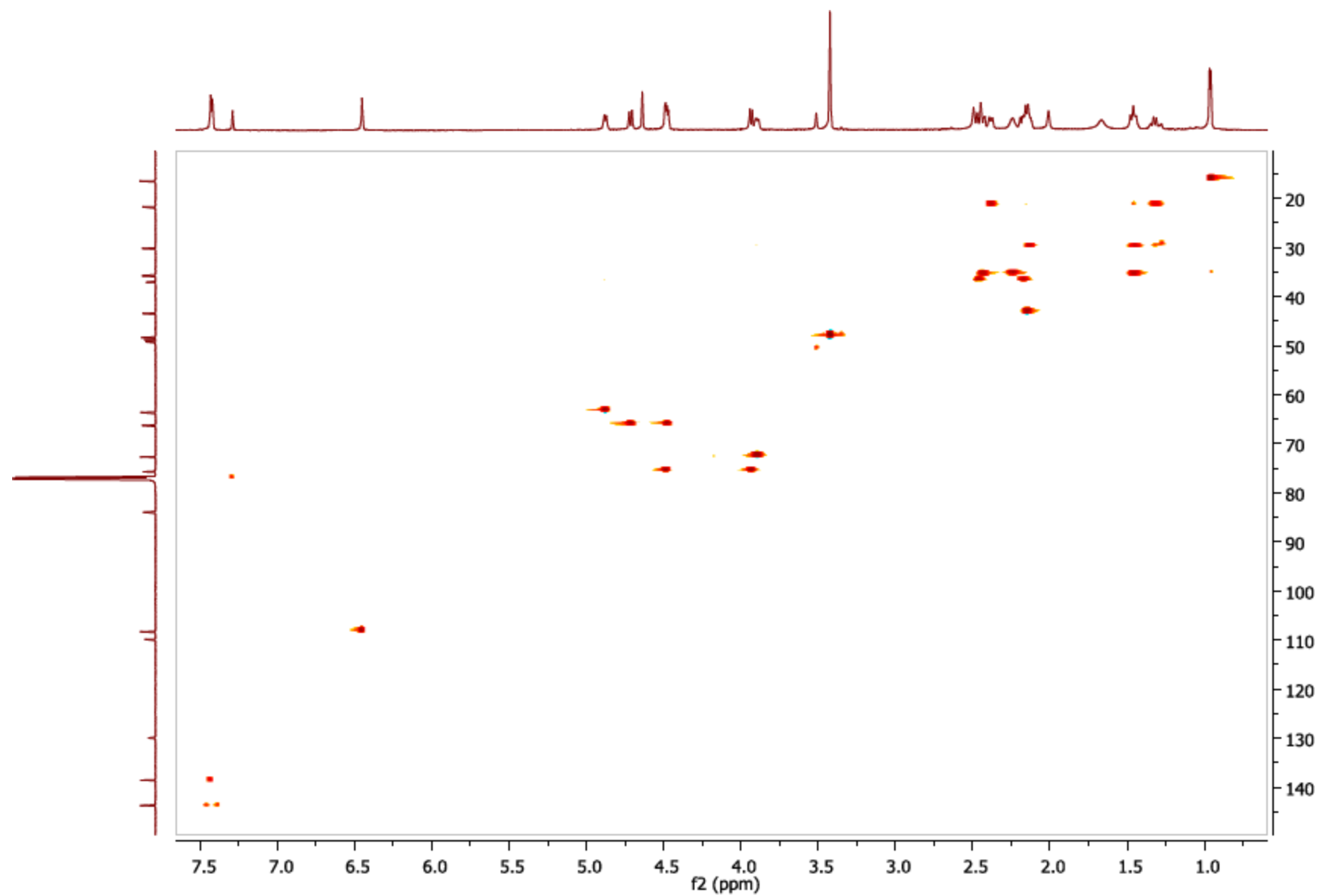
**Figure S21.** <sup>13</sup>C NMR spectrum of **3** in CD<sub>3</sub>OD.



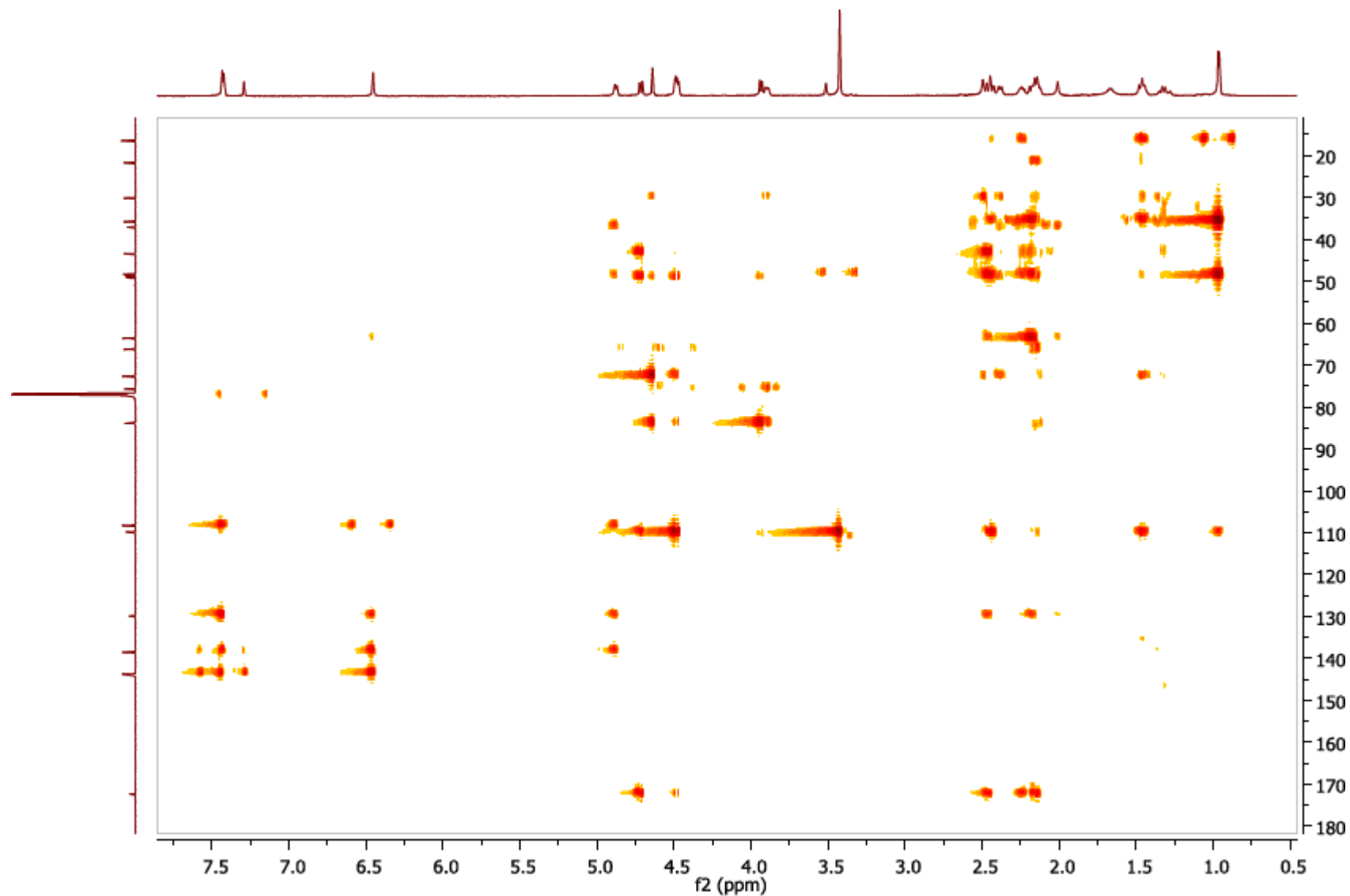
**Figure S22.** COSY NMR spectrum of **3** in CD<sub>3</sub>OD.



**Figure S23.** NOESY NMR spectrum of **3** in CD<sub>3</sub>OD.

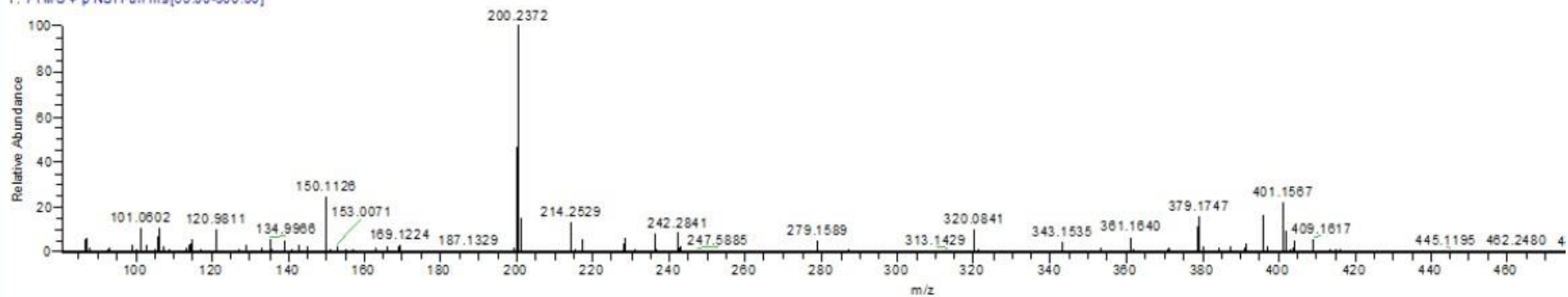


**Figure S24.** HSQC NMR spectrum of **3** in CD<sub>3</sub>OD.

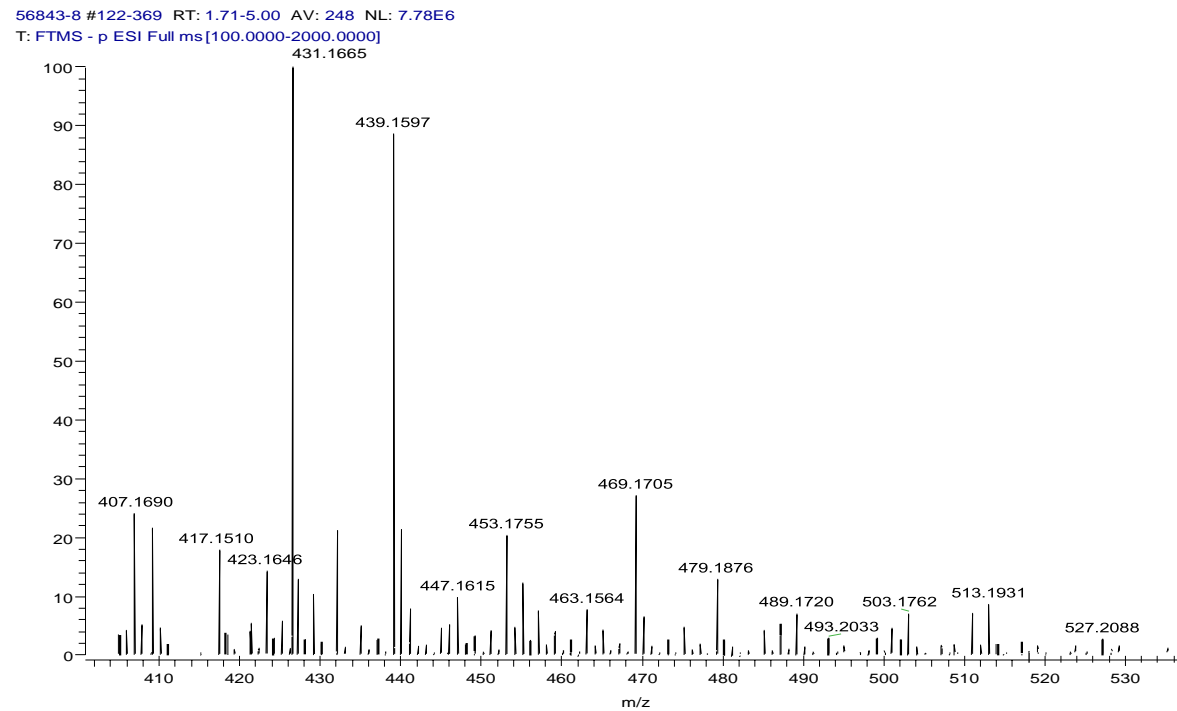


**Figure S25.** HMBC NMR spectrum of **3** in CD<sub>3</sub>OD.

29\_03 #15 RT: 0.22 AV: 1 NL: 6.54E7  
T: FTMS + p NSI Full ms[60.00-900.00]

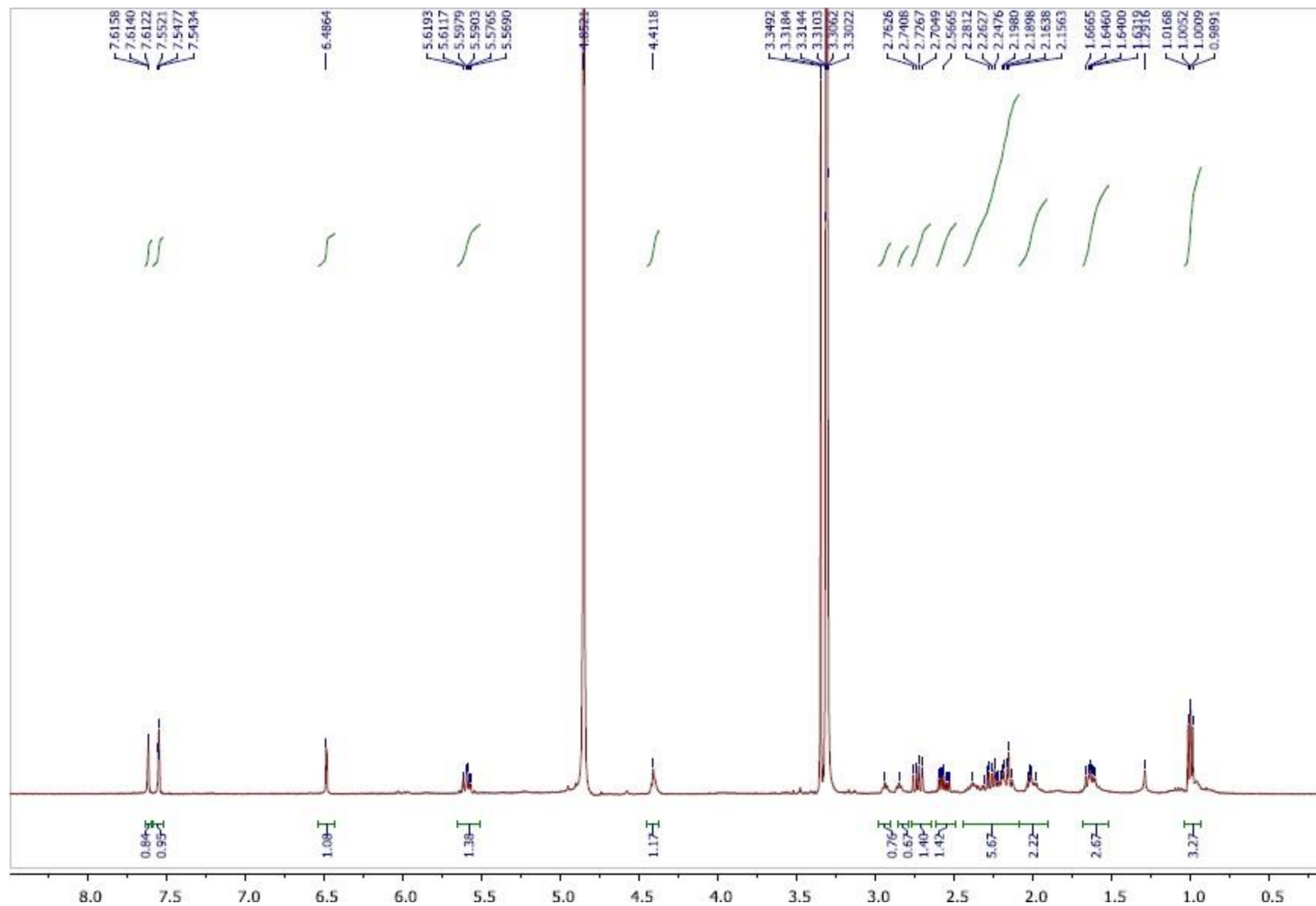


**Figure S26.** Positive-ion HRESIMS of **3**.

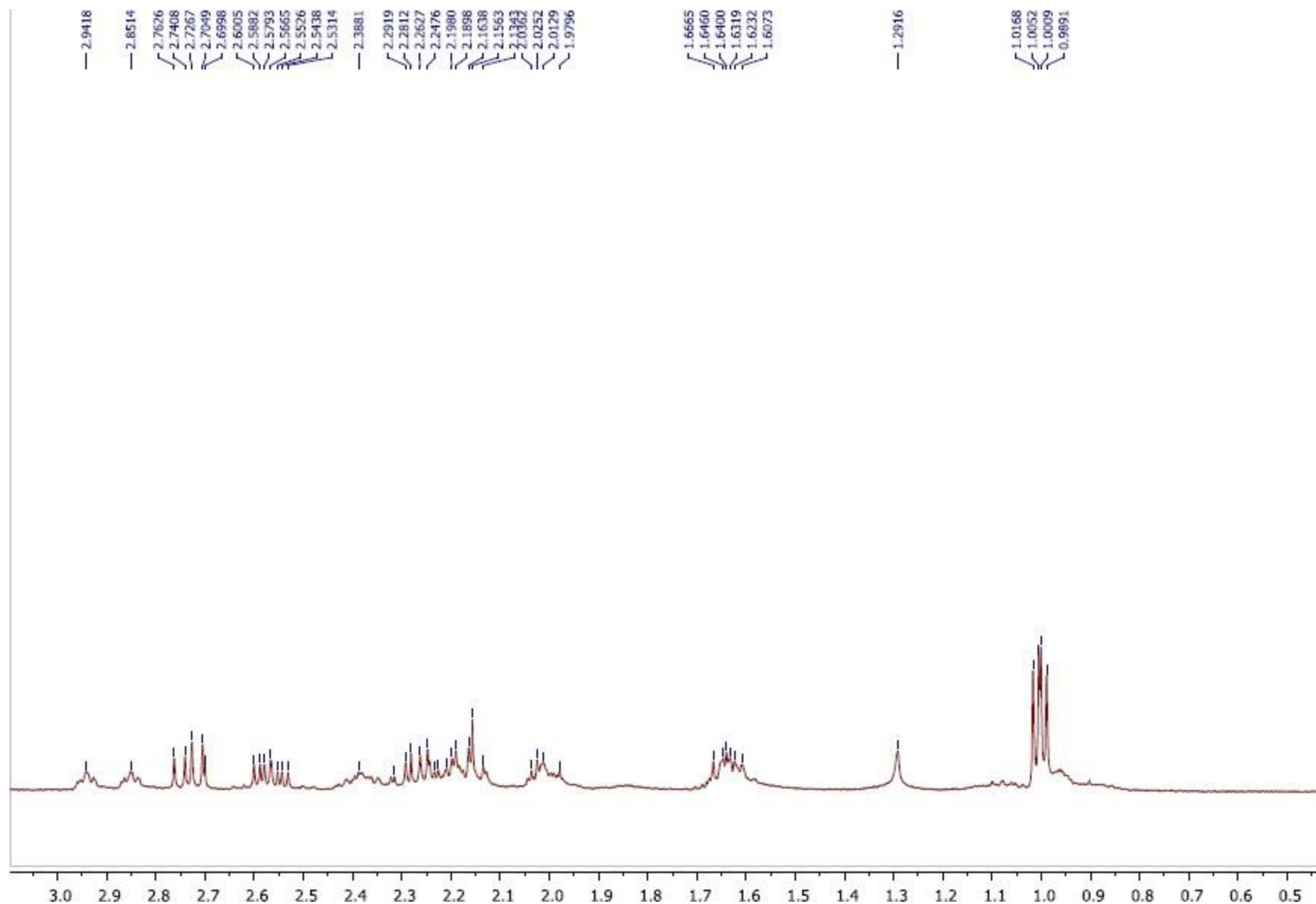


**Figure S27.** Negative-ion HRESIMS of **3**.

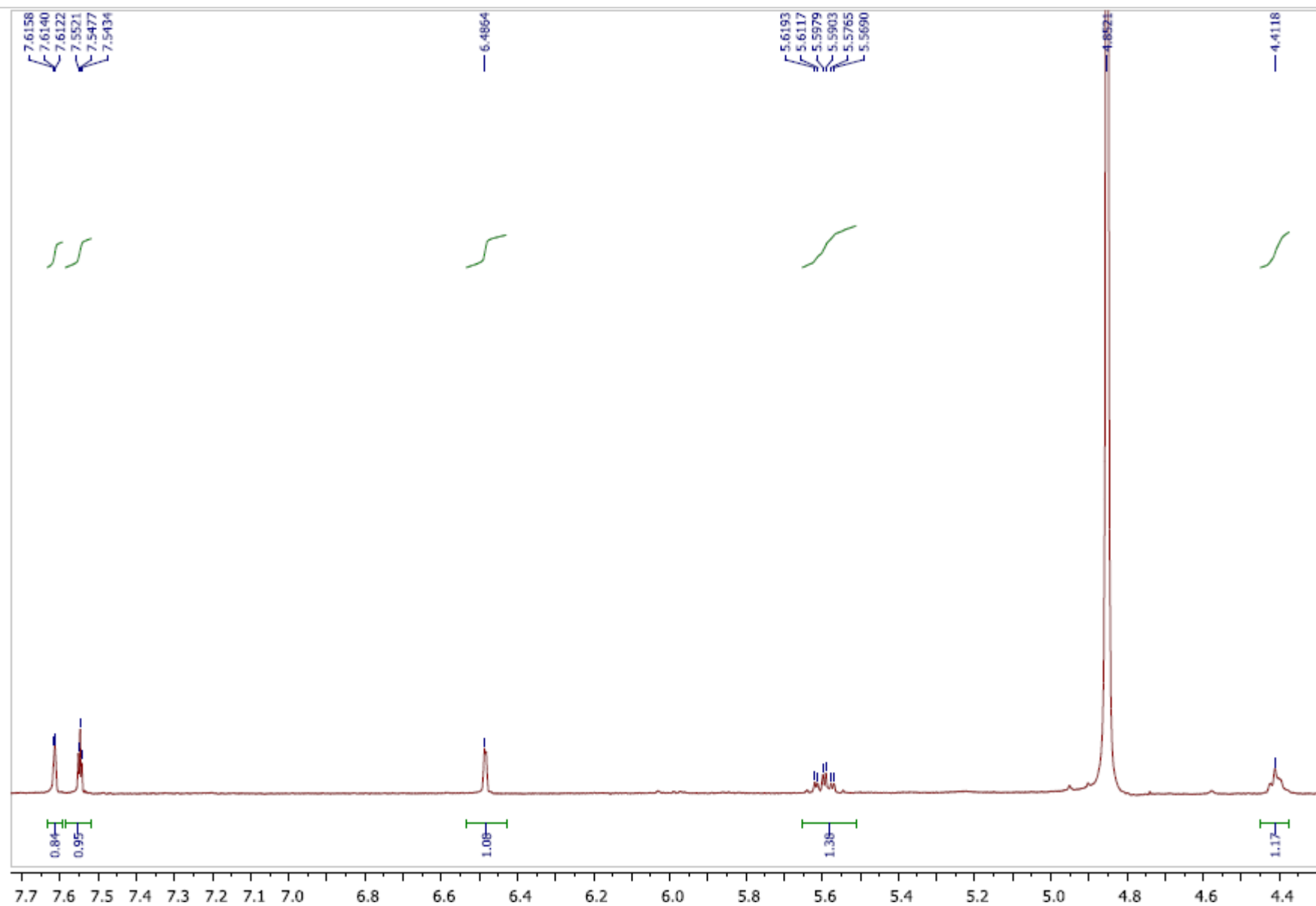




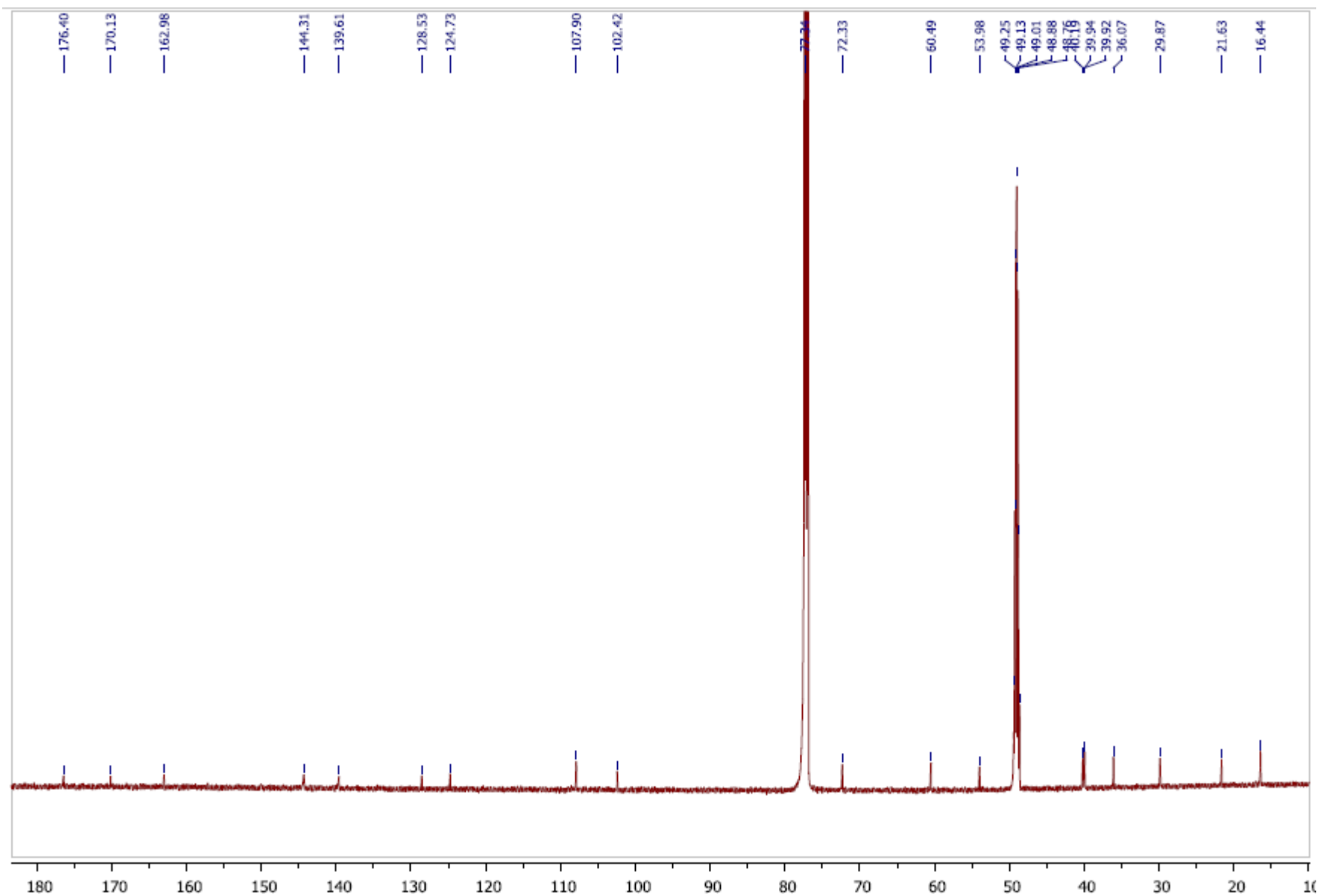
**Figure S28.**  $^1\text{H}$  NMR spectrum of **4** in  $\text{CD}_3\text{OD}$ .



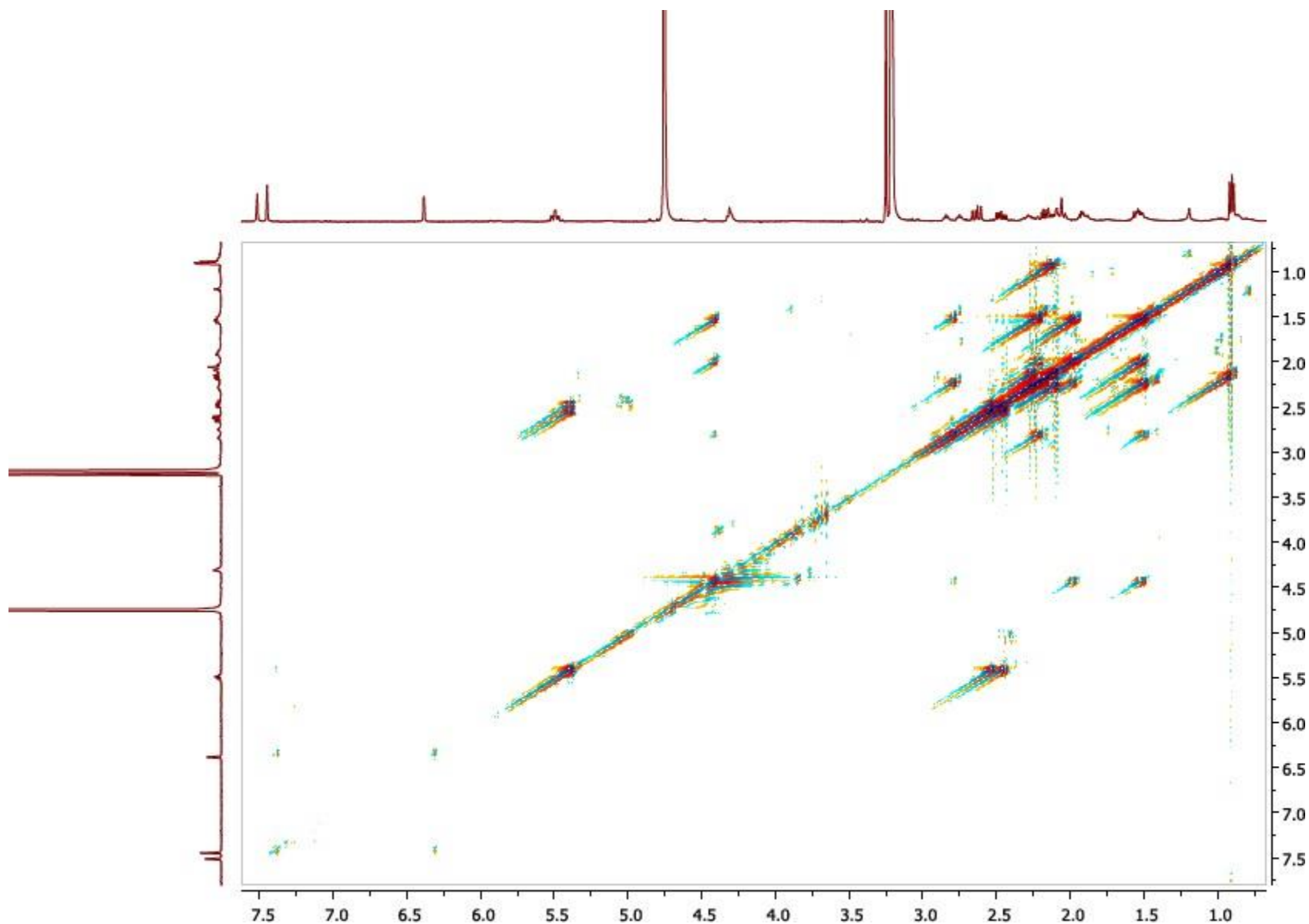
**Figure S29.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.5 –  $\delta$  3.0) of **4** in  $\text{CD}_3\text{OD}$ .



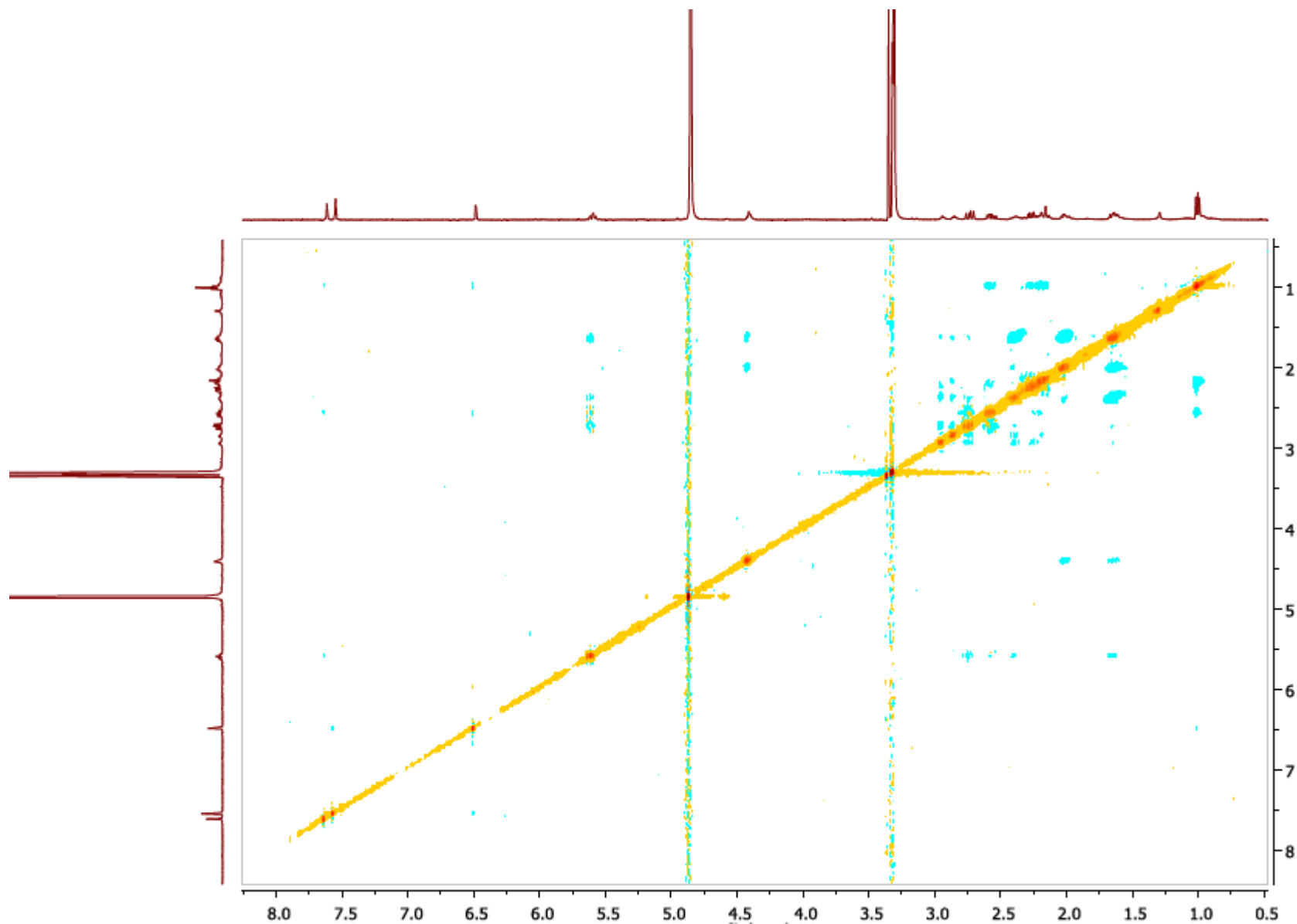
**Figure S30.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  4.3 –  $\delta$  7.7) of **4** in  $\text{CD}_3\text{OD}$ .



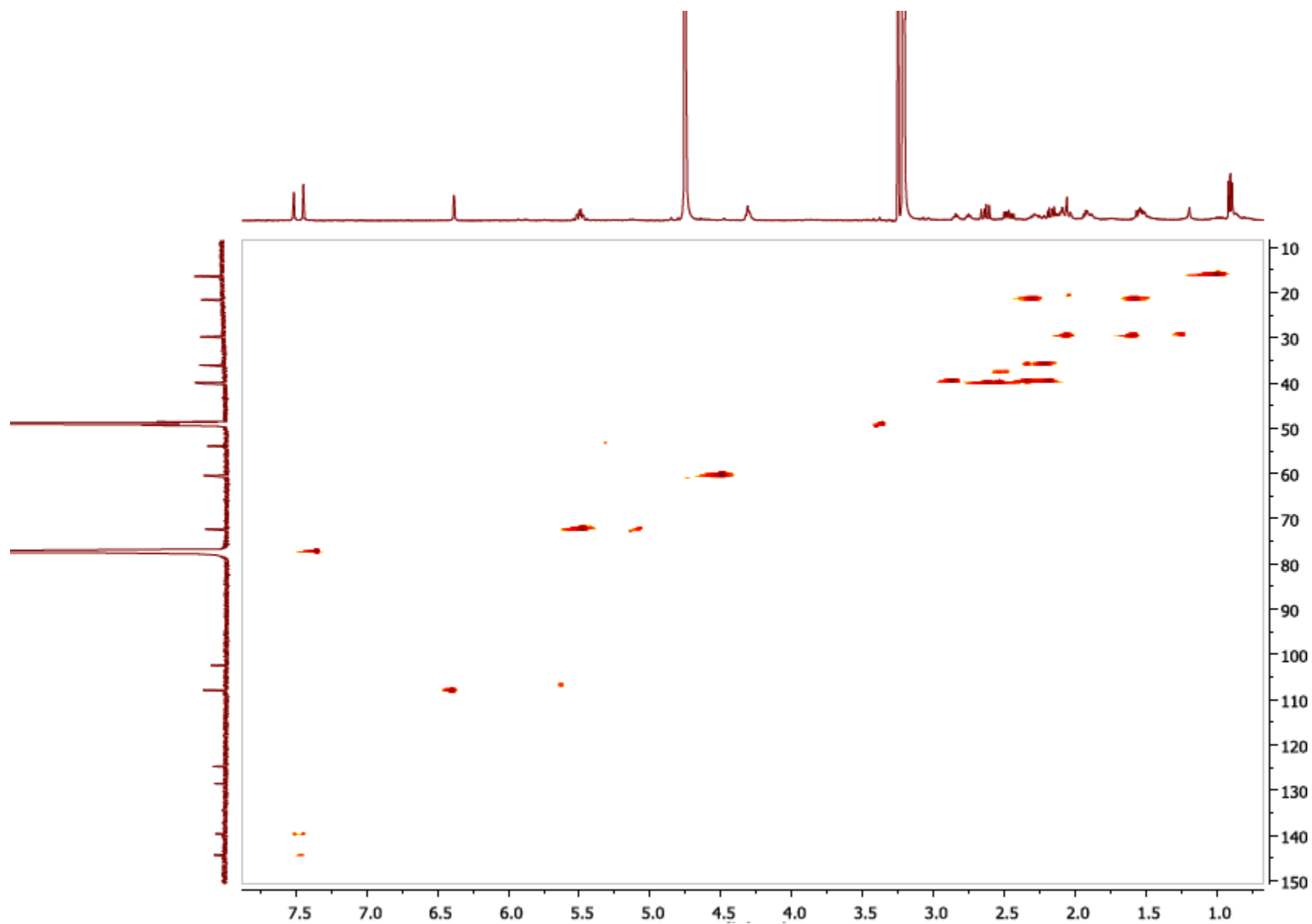
**Figure S31.** <sup>13</sup>C NMR spectrum of **4** in CD<sub>3</sub>OD / CDCl<sub>3</sub>.



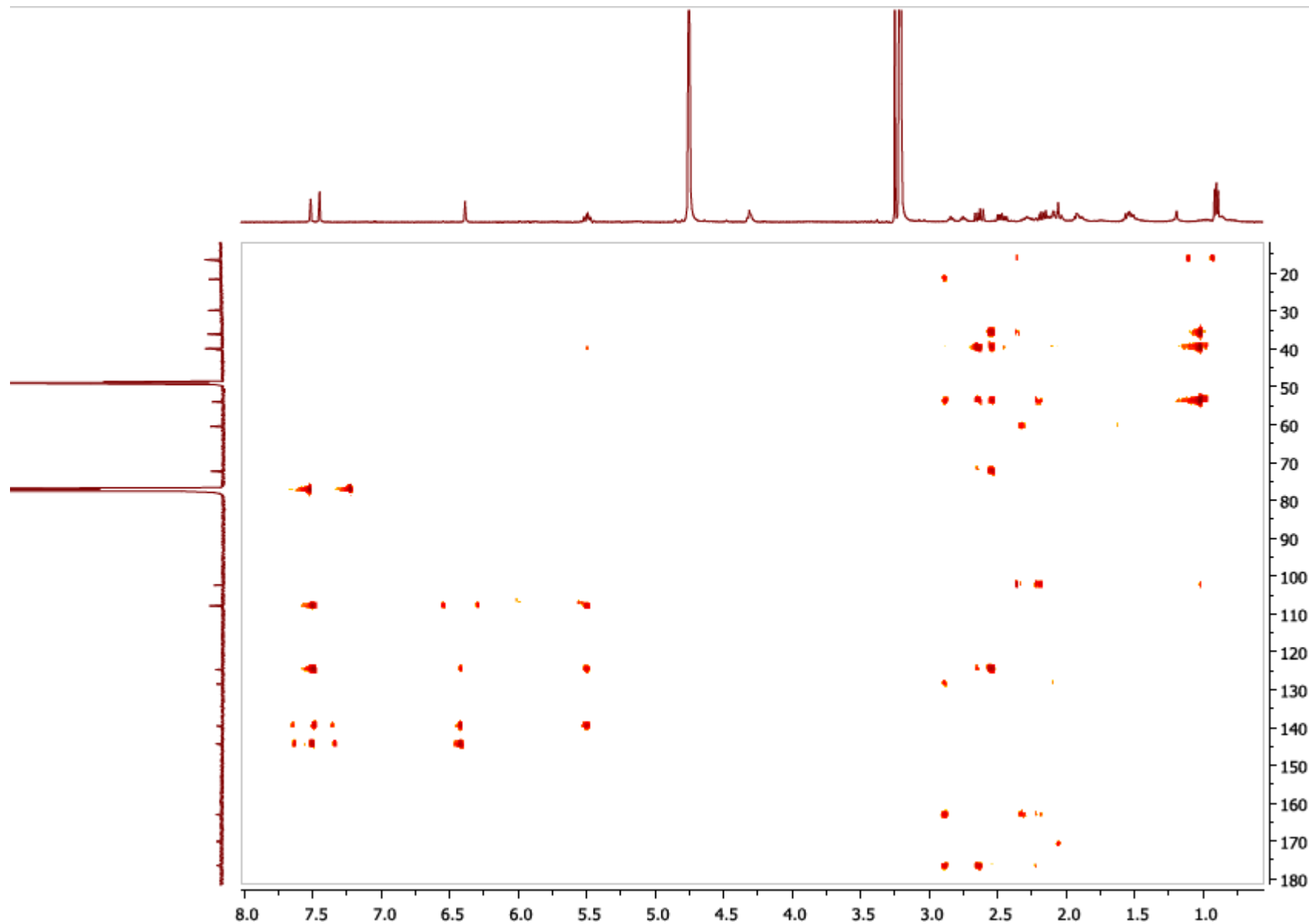
**Figure S32.** COSY NMR spectrum of **4** in CD<sub>3</sub>OD.



**Figure S33.** NOESY NMR spectrum of **4** in CD<sub>3</sub>OD.

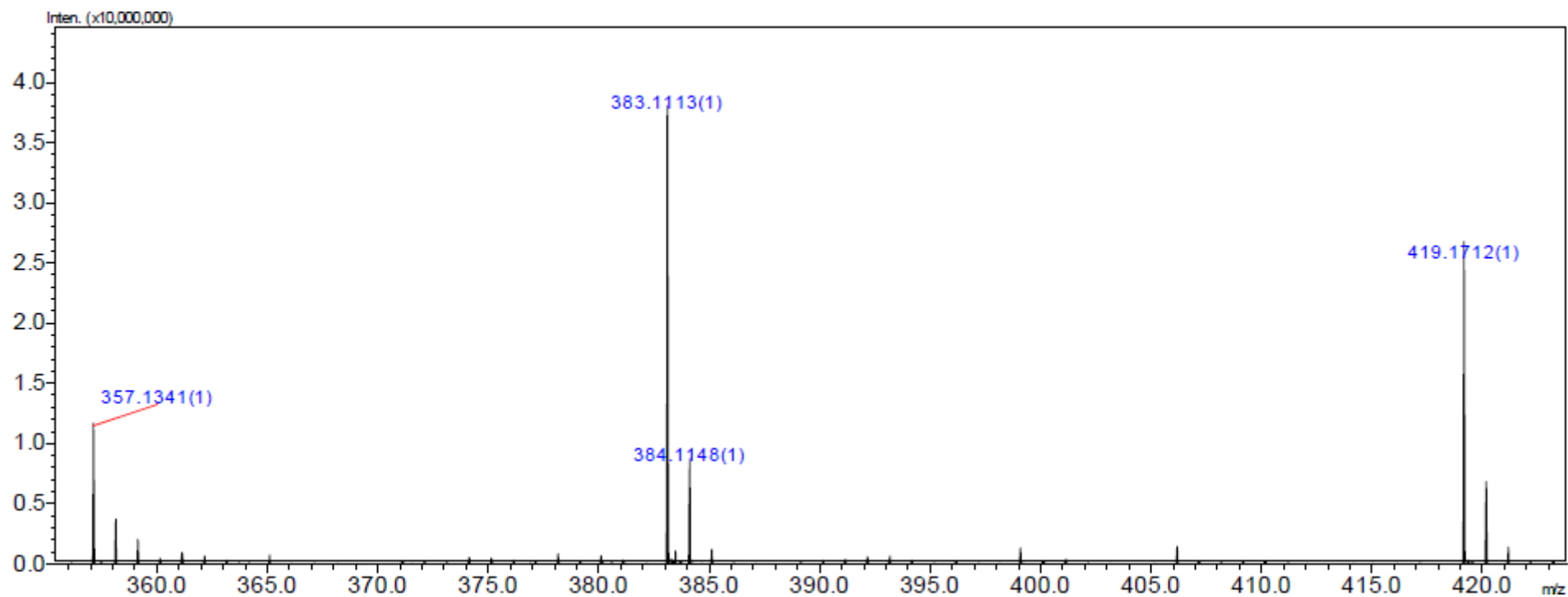


**Figure S34.** HSQC NMR spectrum of **4** in CD<sub>3</sub>OD.

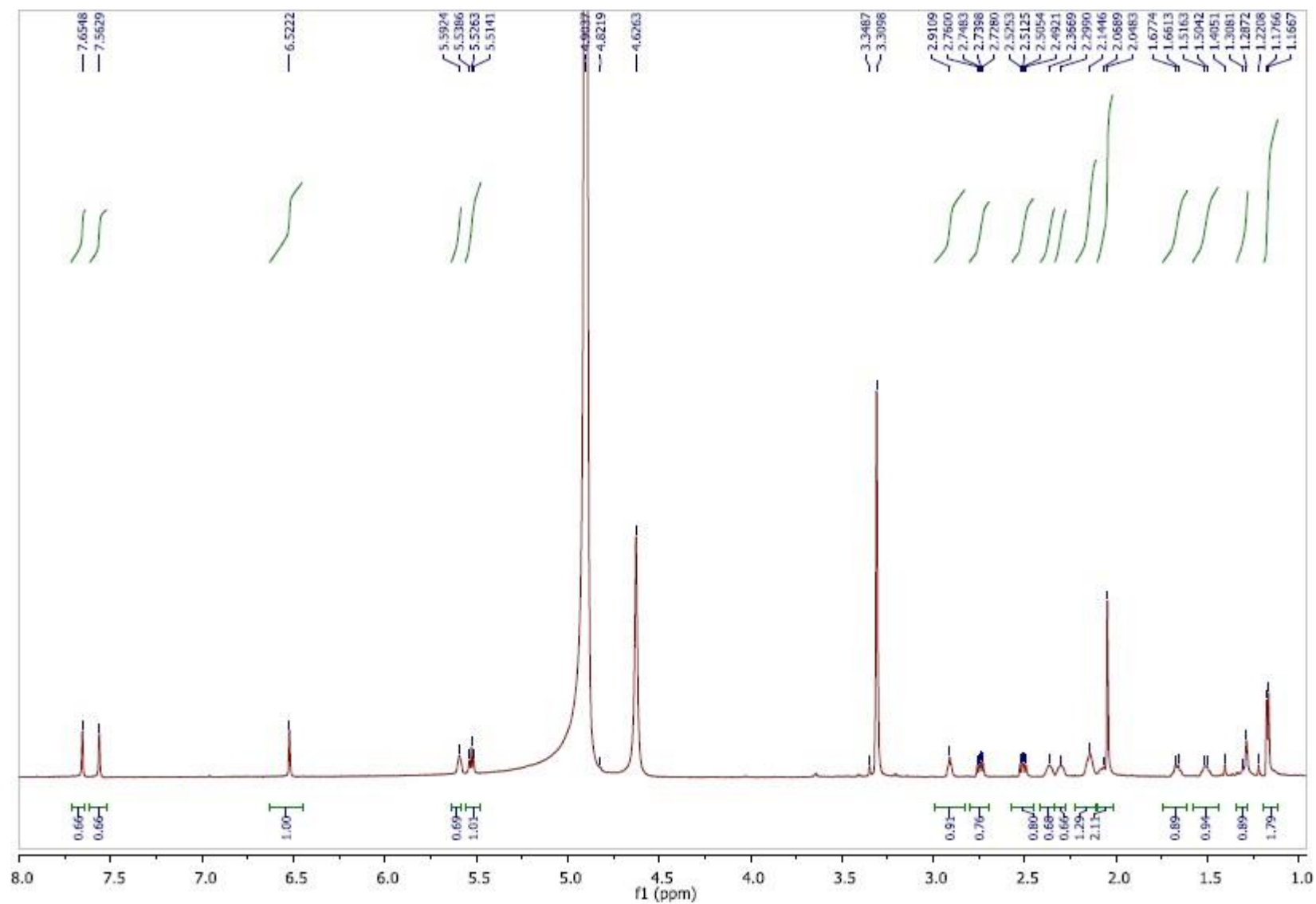


**Figure S35.** HMBC NMR spectrum of **4** in CD<sub>3</sub>OD.

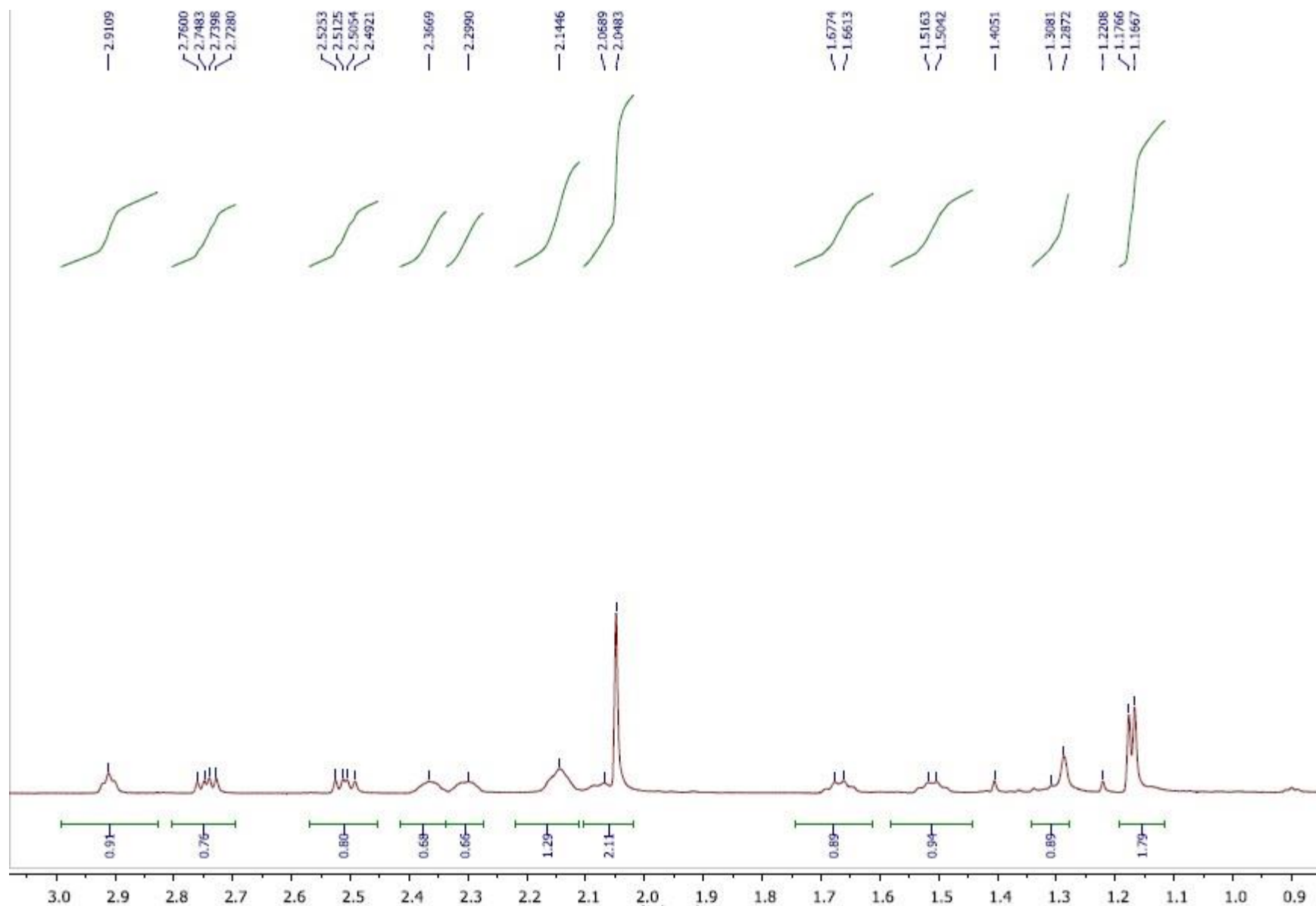




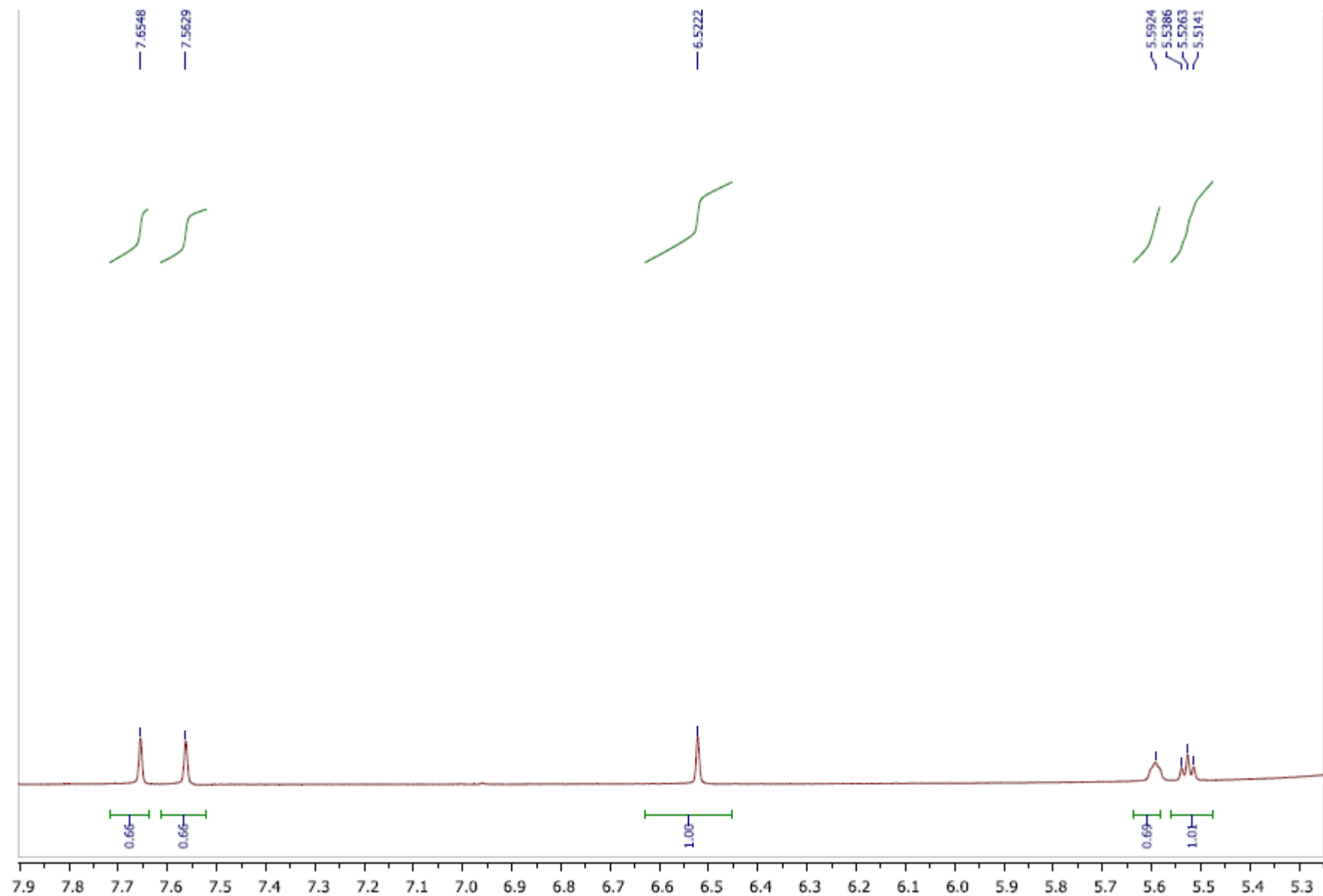
**Figure S36.** Positive-ion HRESIMS of **4**.



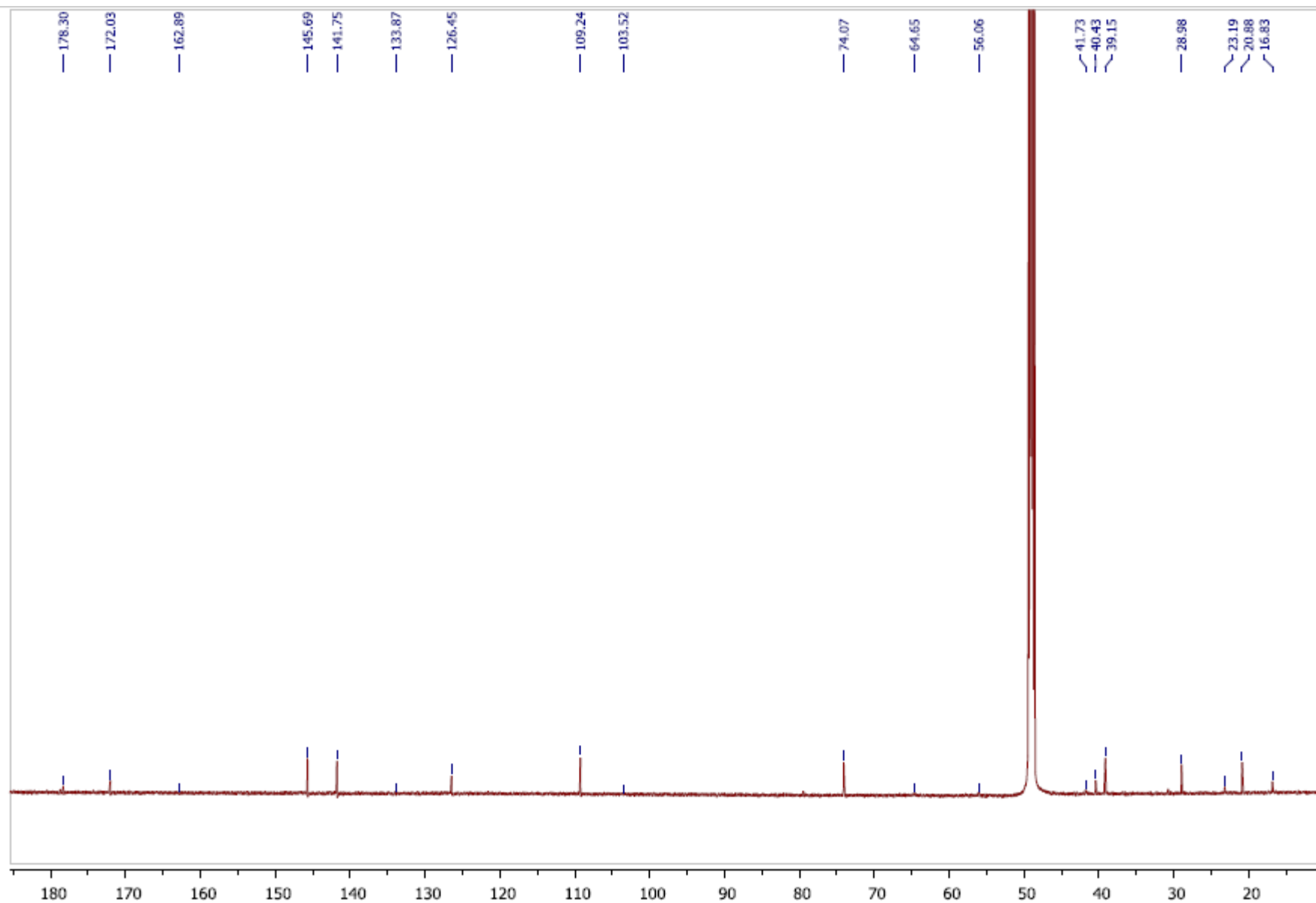
**Figure S37.** <sup>1</sup>H NMR spectrum of **5** in CD<sub>3</sub>OD.



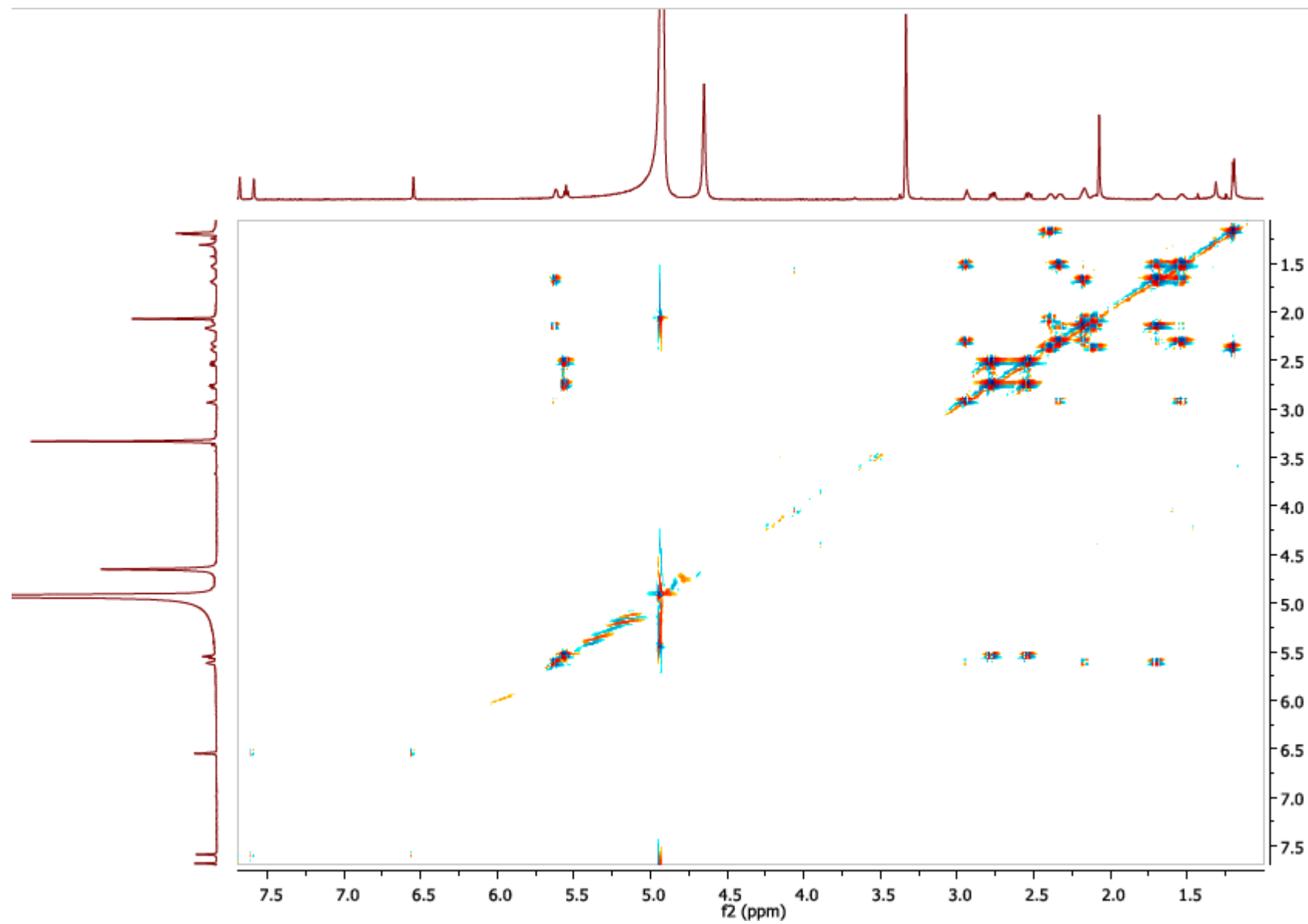
**Figure S38.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.9 –  $\delta$  3.0) of **5** in  $\text{CD}_3\text{OD}$ .



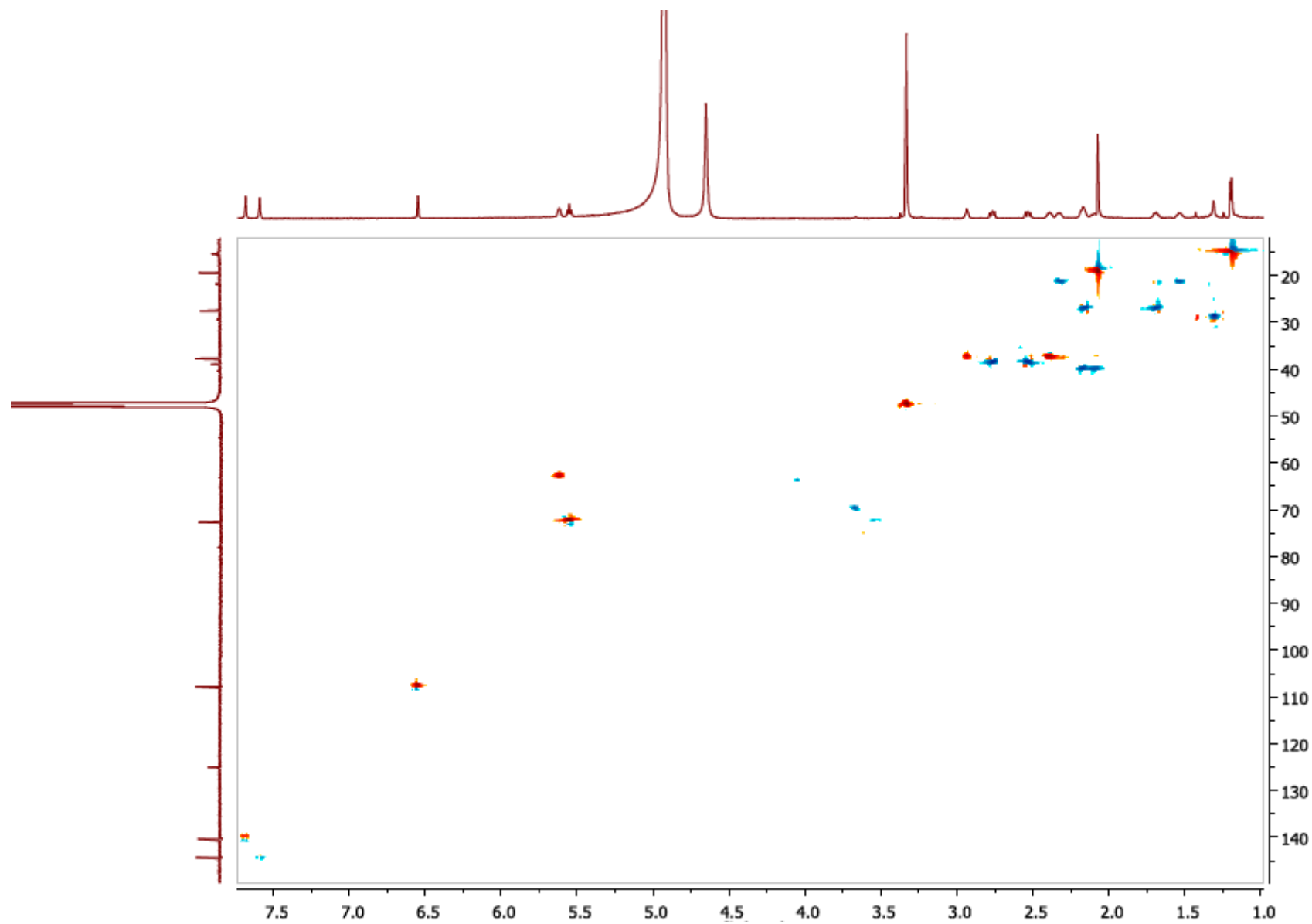
**Figure S39.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  5.3 –  $\delta$  7.9) of **5** in  $\text{CD}_3\text{OD}$ .



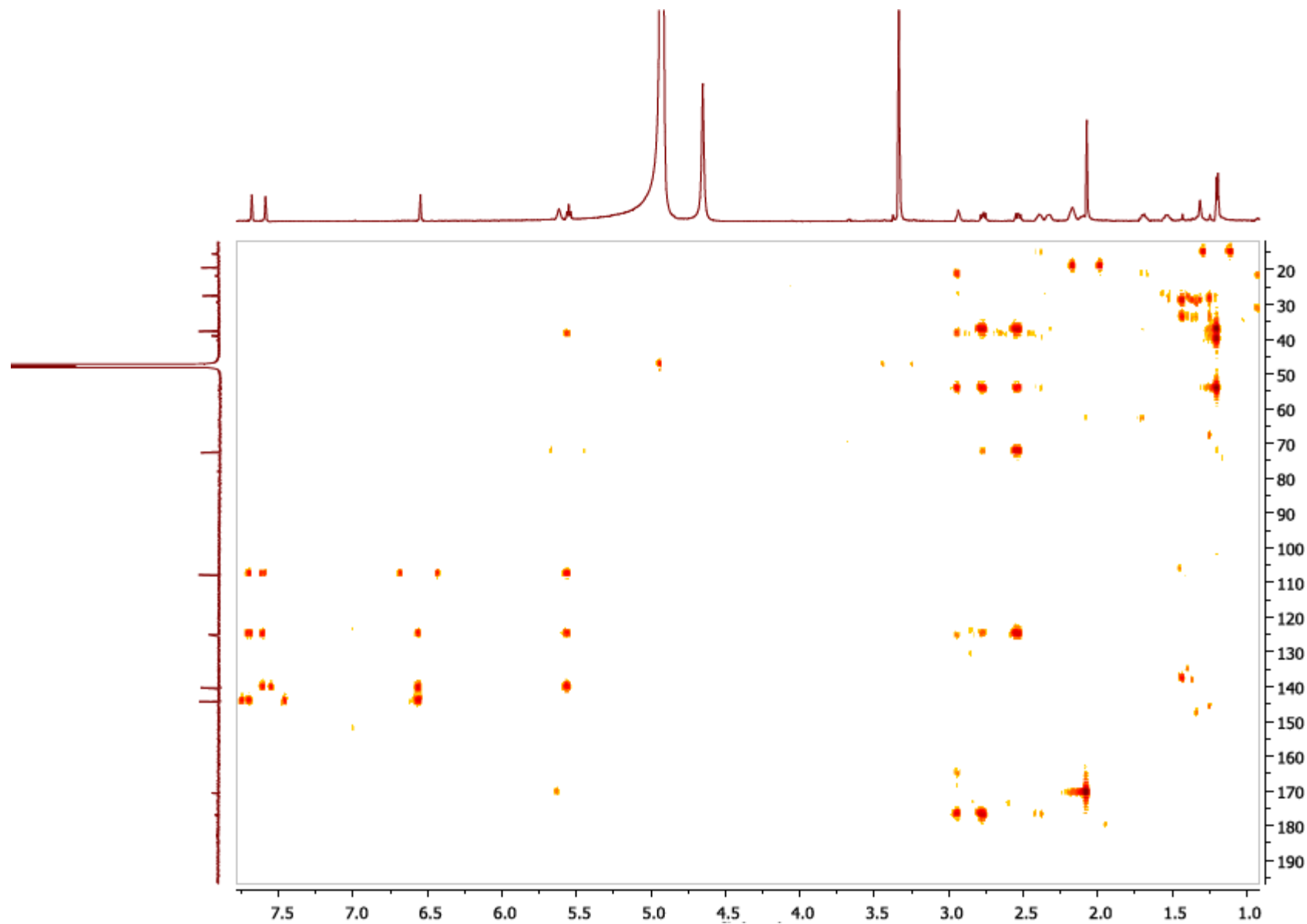
**Figure S40.**  $^{13}\text{C}$  NMR spectrum of **5** in  $\text{CD}_3\text{OD}$ .



**Figure S41.** COSY NMR spectrum of **5** in CD<sub>3</sub>OD.



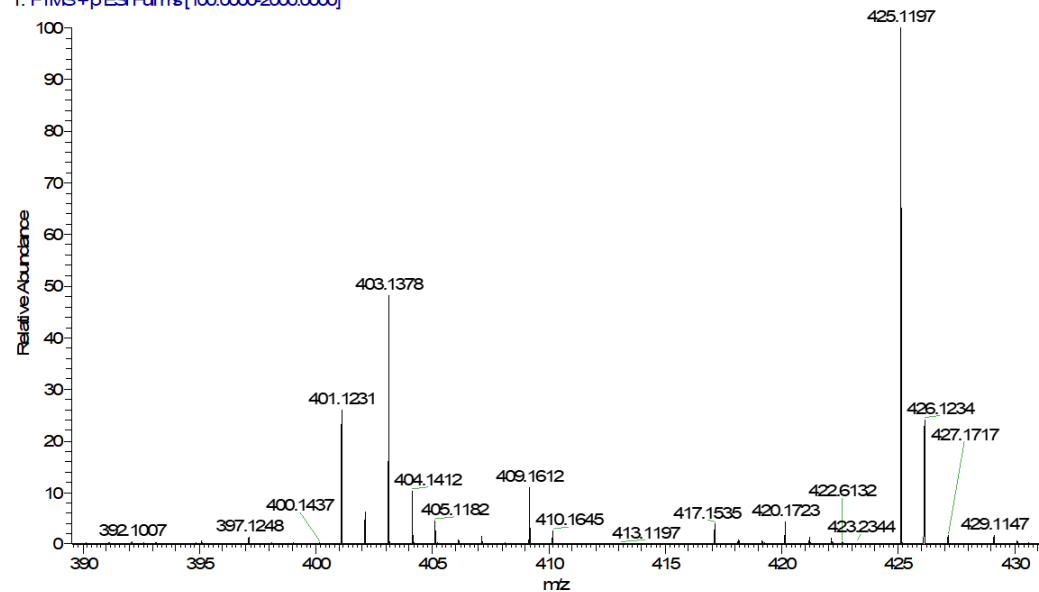
**Figure S42.** HSQC NMR spectrum of **5** in CD<sub>3</sub>OD.



**Figure S43.** HMBC NMR spectrum of **5** in  $\text{CD}_3\text{OD}$ .



5363B37 #167-386 RT: 2.32-5.28 AV: 220 NL: 5.81E6  
T: FTMS+pESI Full ms [100.0000-2000.0000]



5363B37 #193-310 RT: 2.67-4.23 AV: 59 NL: 2.94E7  
F: FTMS+pESI Full ms [100.0000-2000.0000]

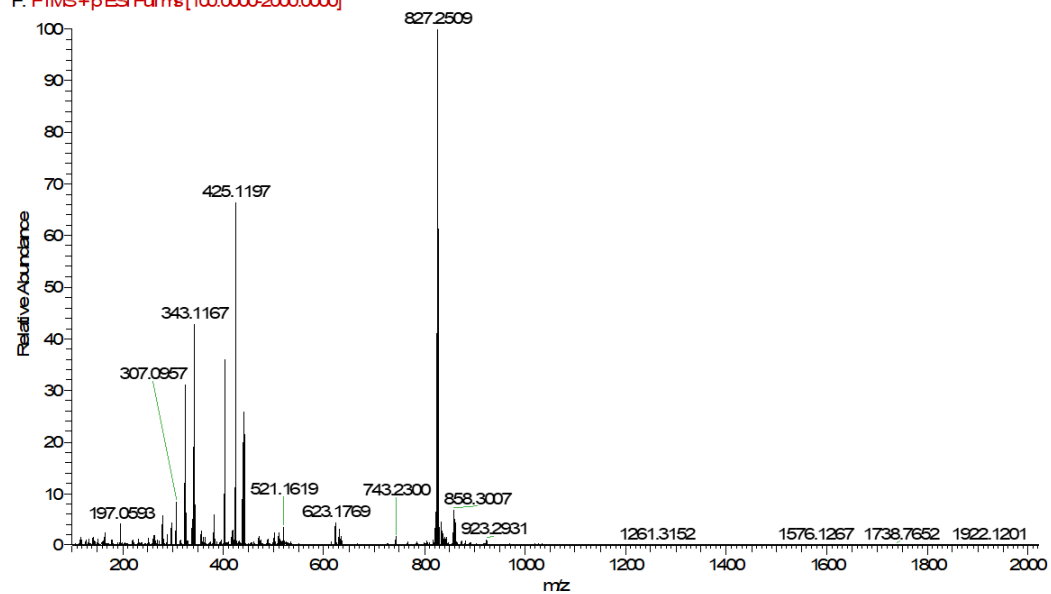
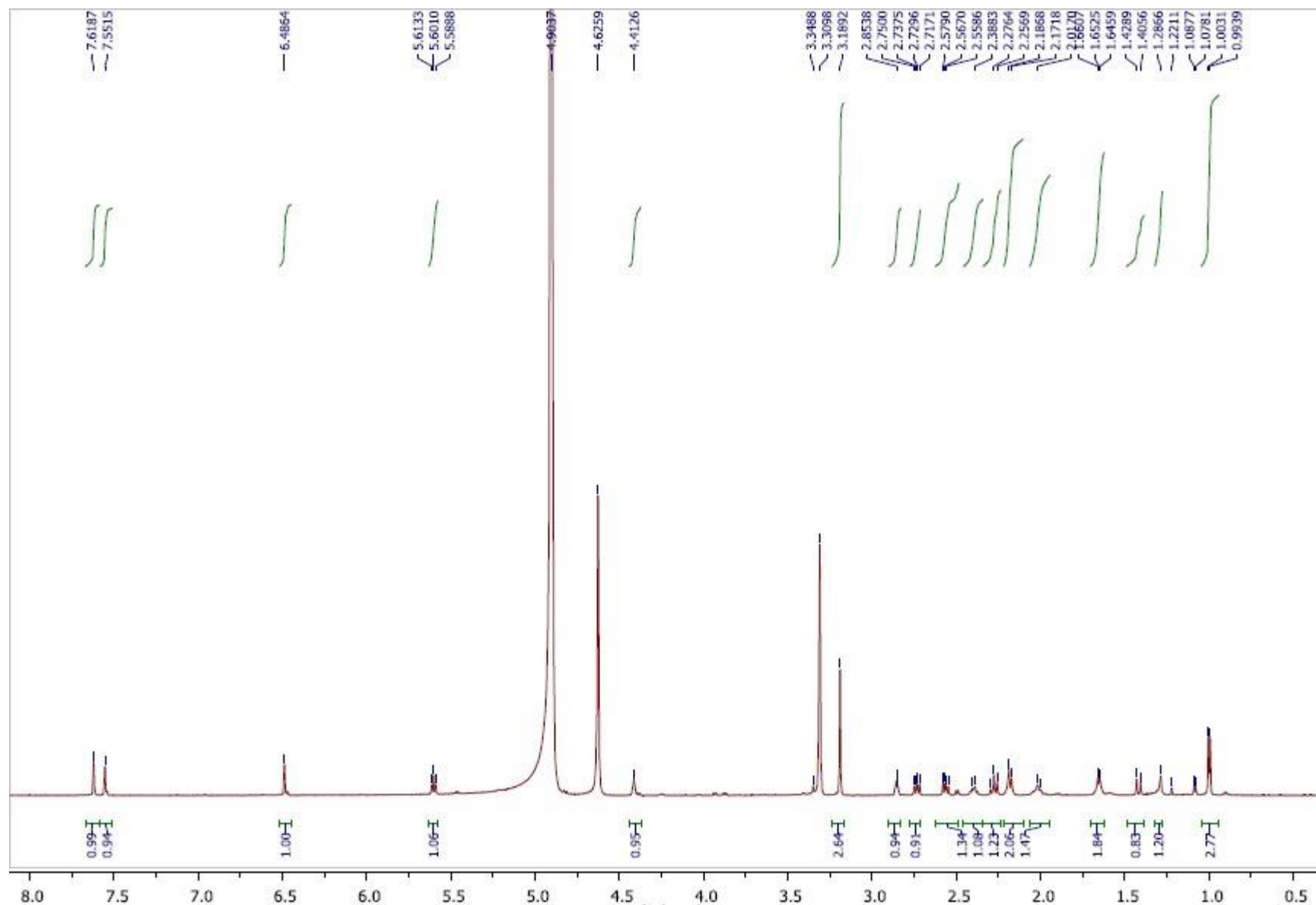
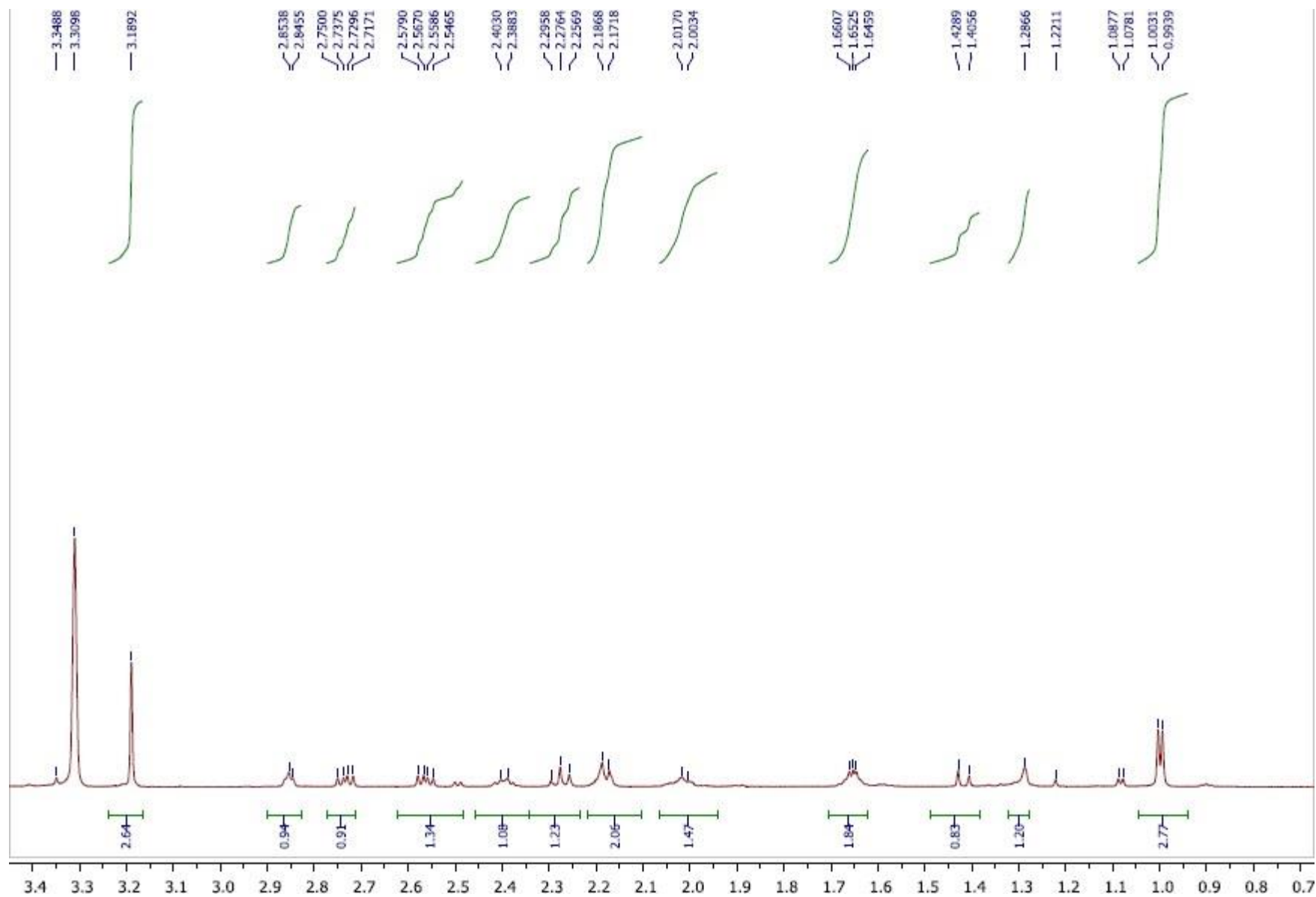


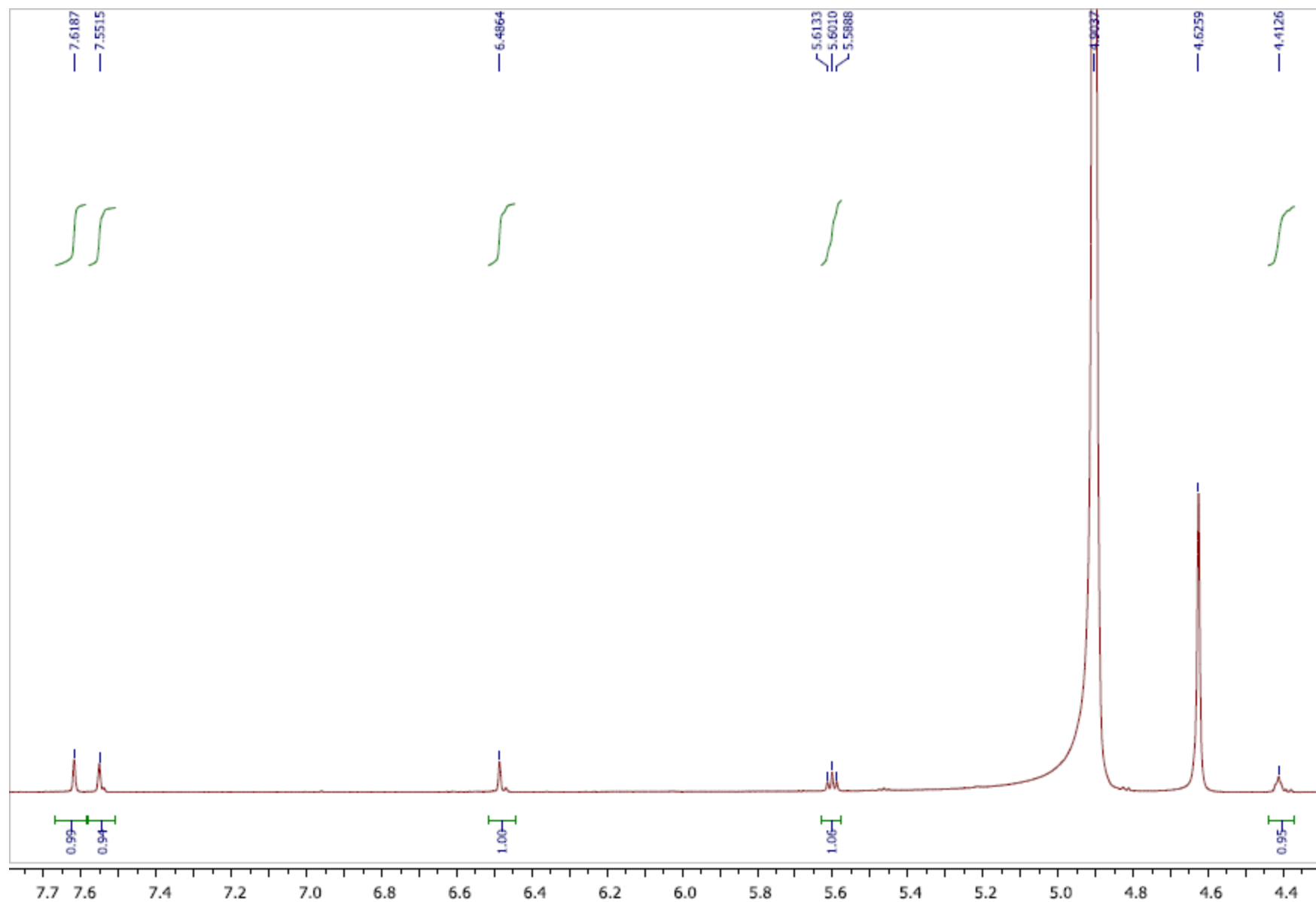
Figure S44. Positive-ion HRESIMS of 5.



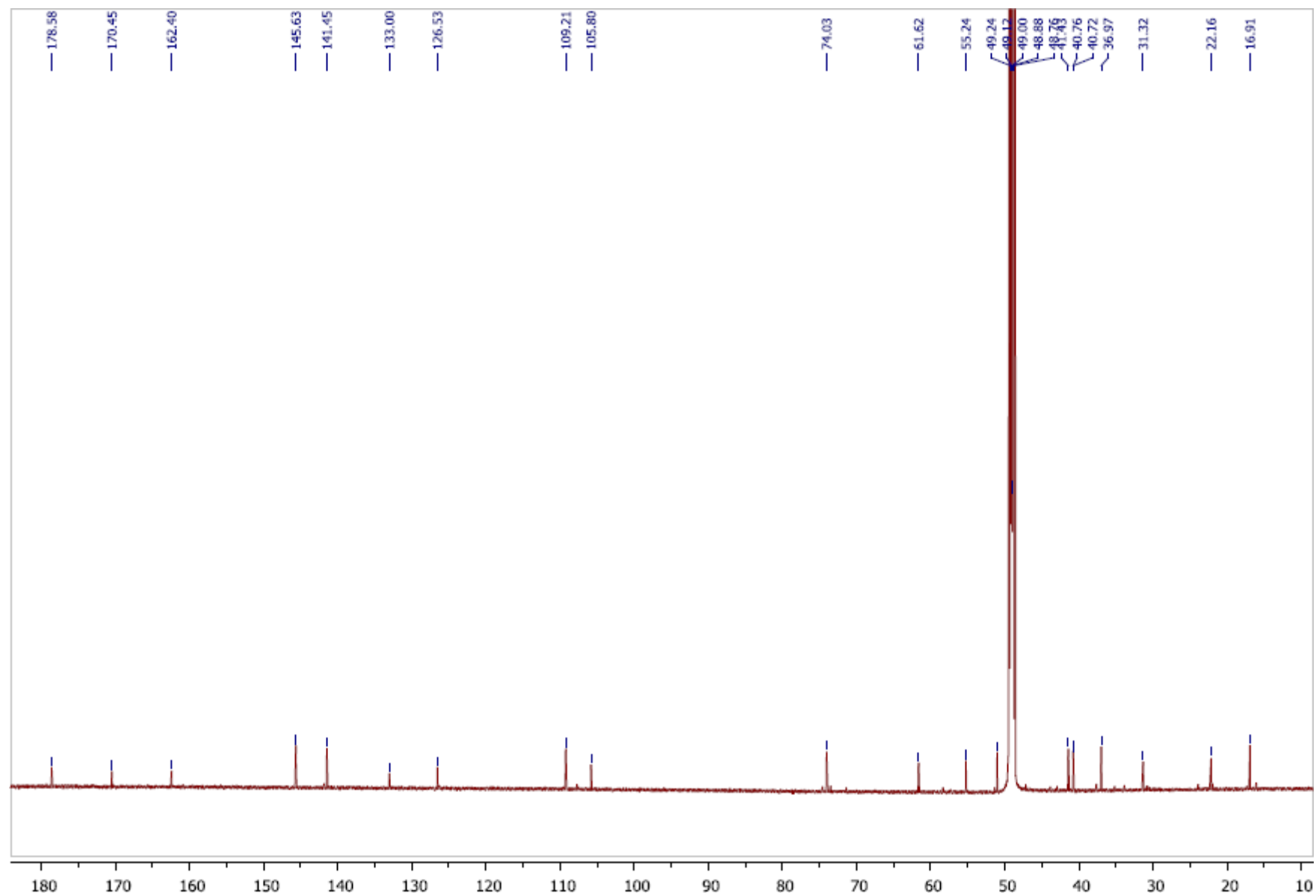
**Figure S45.** <sup>1</sup>H NMR spectrum of **6** in CD<sub>3</sub>OD.



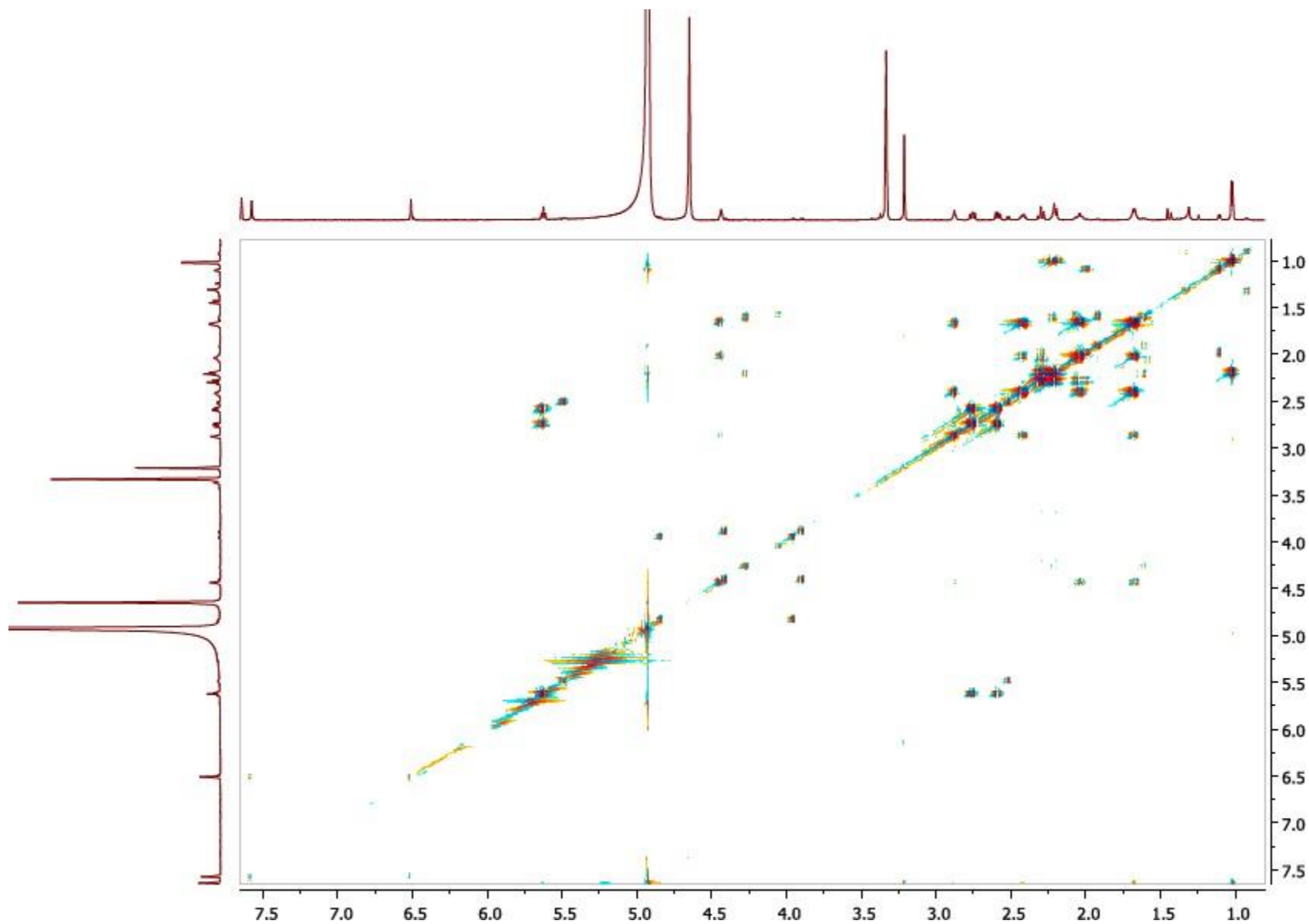
**Figure S46.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.7 –  $\delta$  3.4) of **6** in  $\text{CD}_3\text{OD}$ .



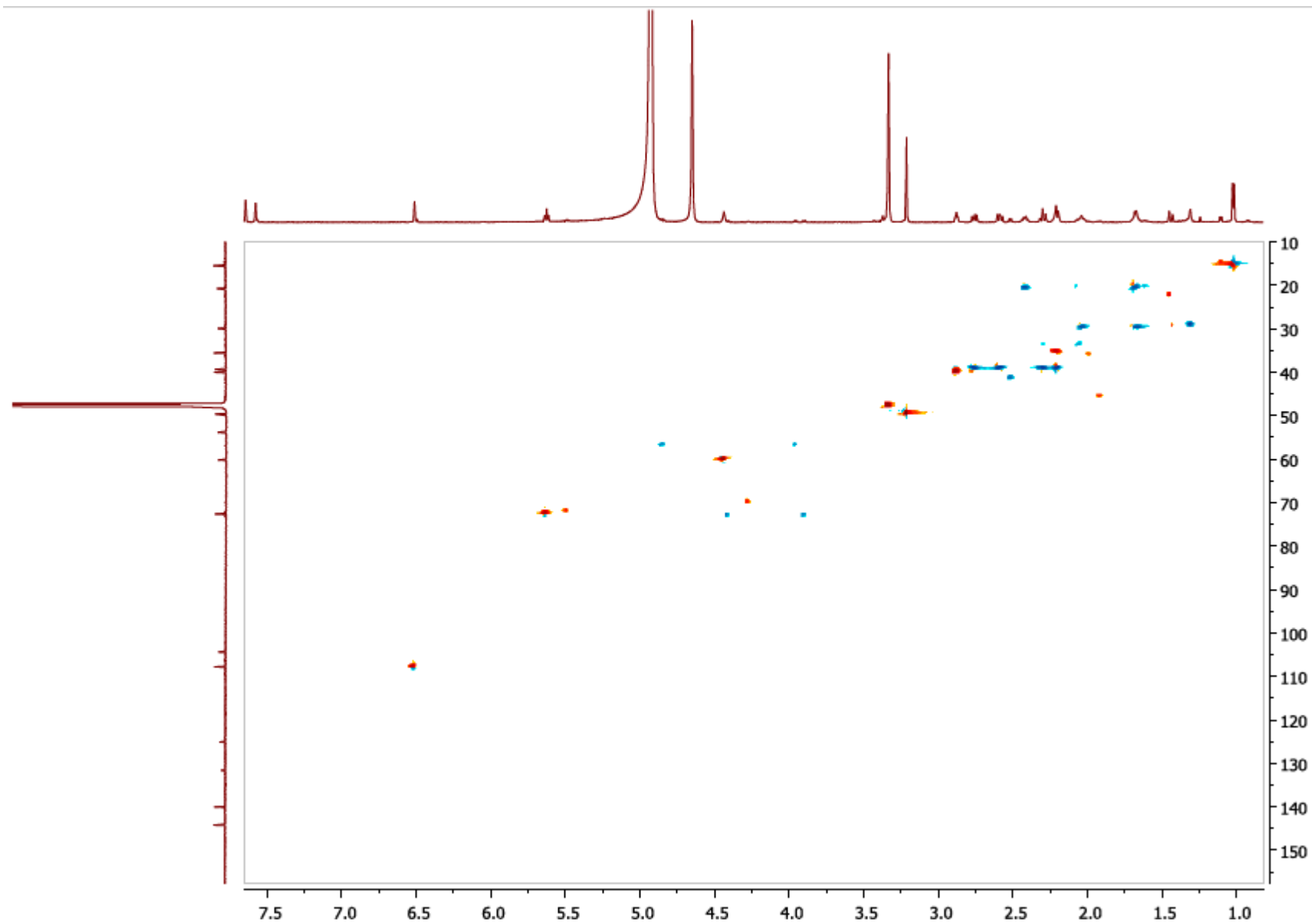
**Figure S47.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  4.3 –  $\delta$  7.7) of **6** in  $\text{CD}_3\text{OD}$ .



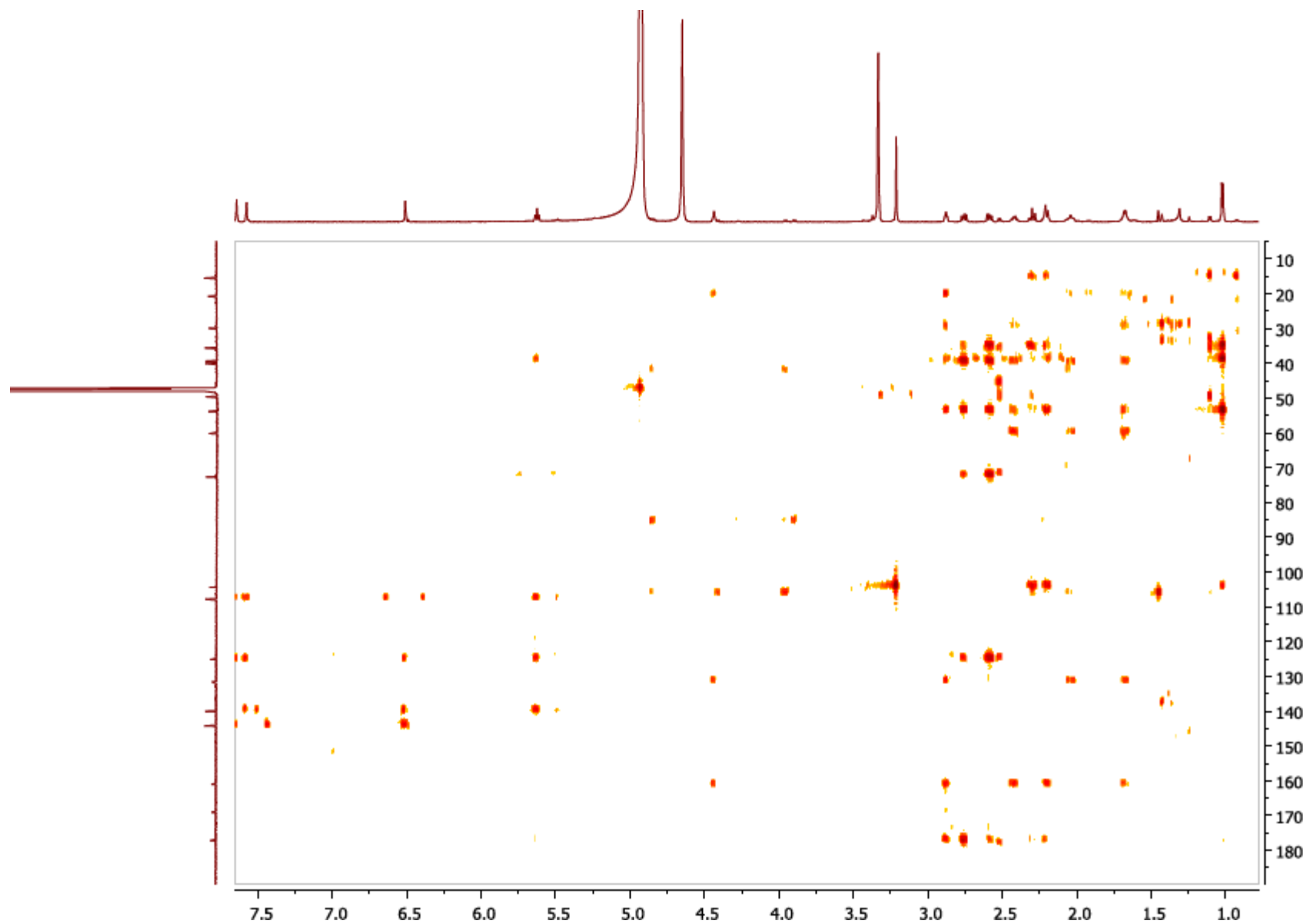
**Figure S48.** <sup>13</sup>C NMR spectrum of **6** in CD<sub>3</sub>OD.



**Figure S49.** COSY NMR spectrum of **6** in CD<sub>3</sub>OD.



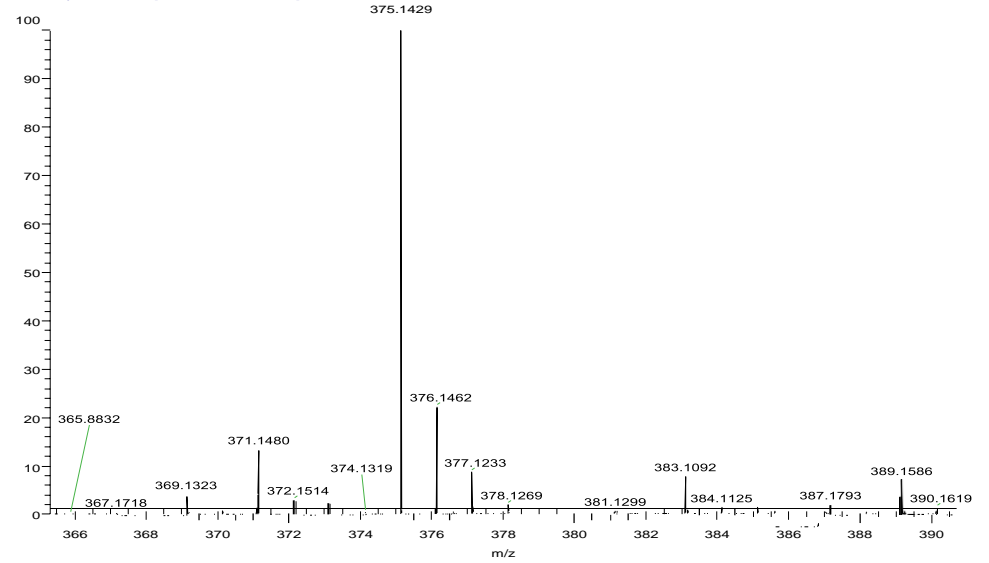
**Figure S50.** HSQC NMR spectrum of **6** in CD<sub>3</sub>OD.



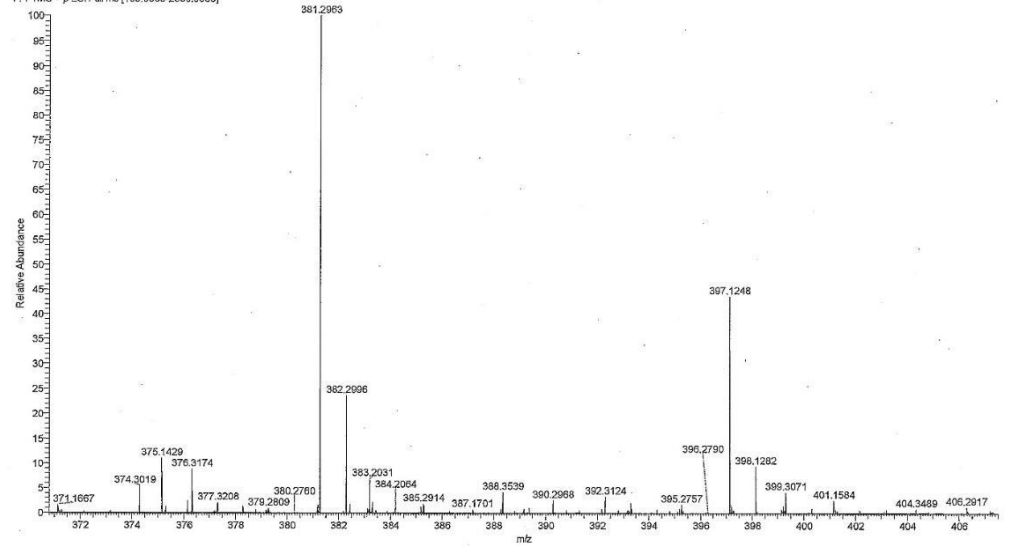
**Figure S51.** HMBC NMR spectrum of **6** in CD<sub>3</sub>OD.



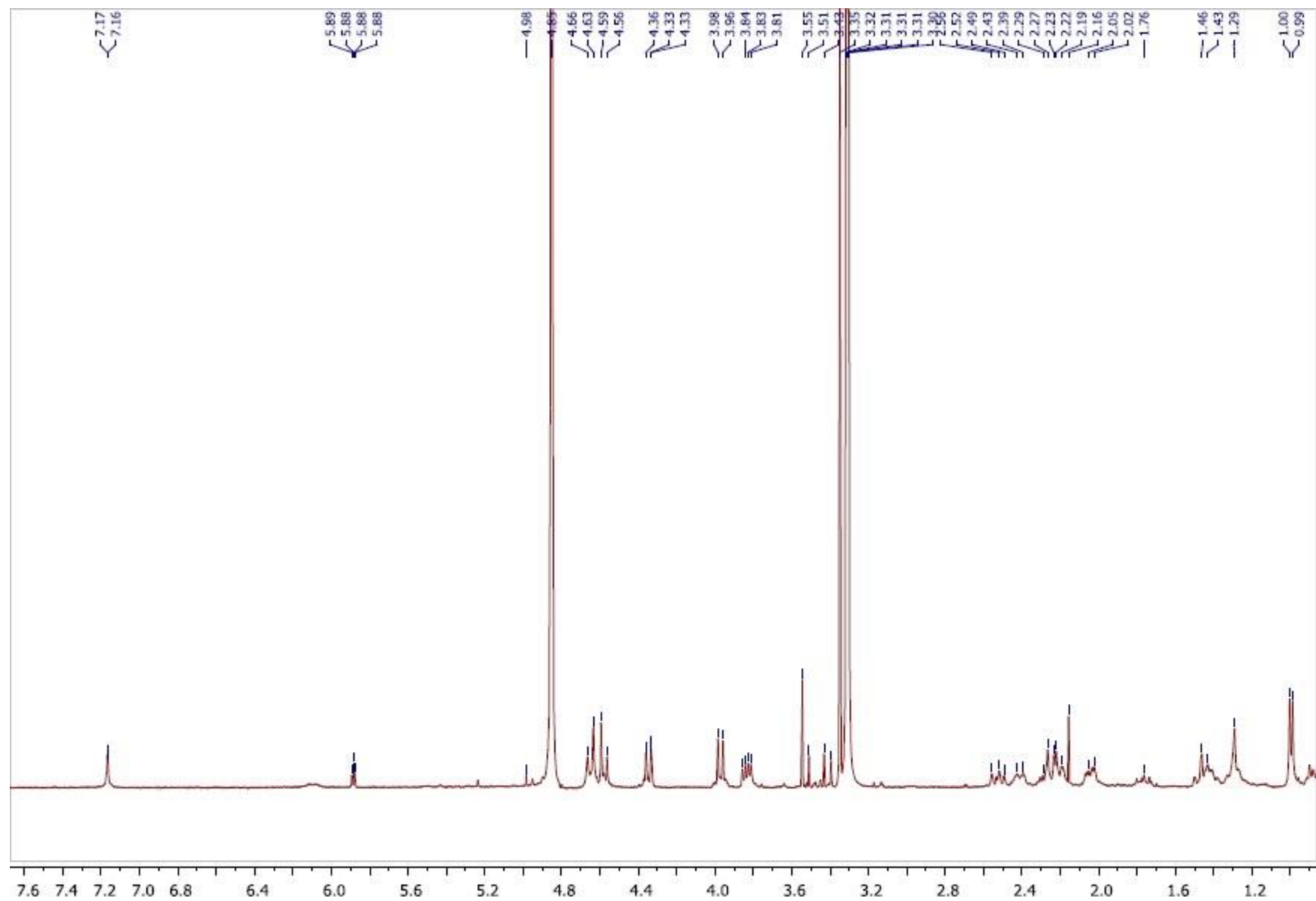
5363B35 #183-328 RT: 2.57-4.56 AV: 146 NL: 2.53E6  
T: FTMS + p ESI Full ms [100.0000-2000.0000]



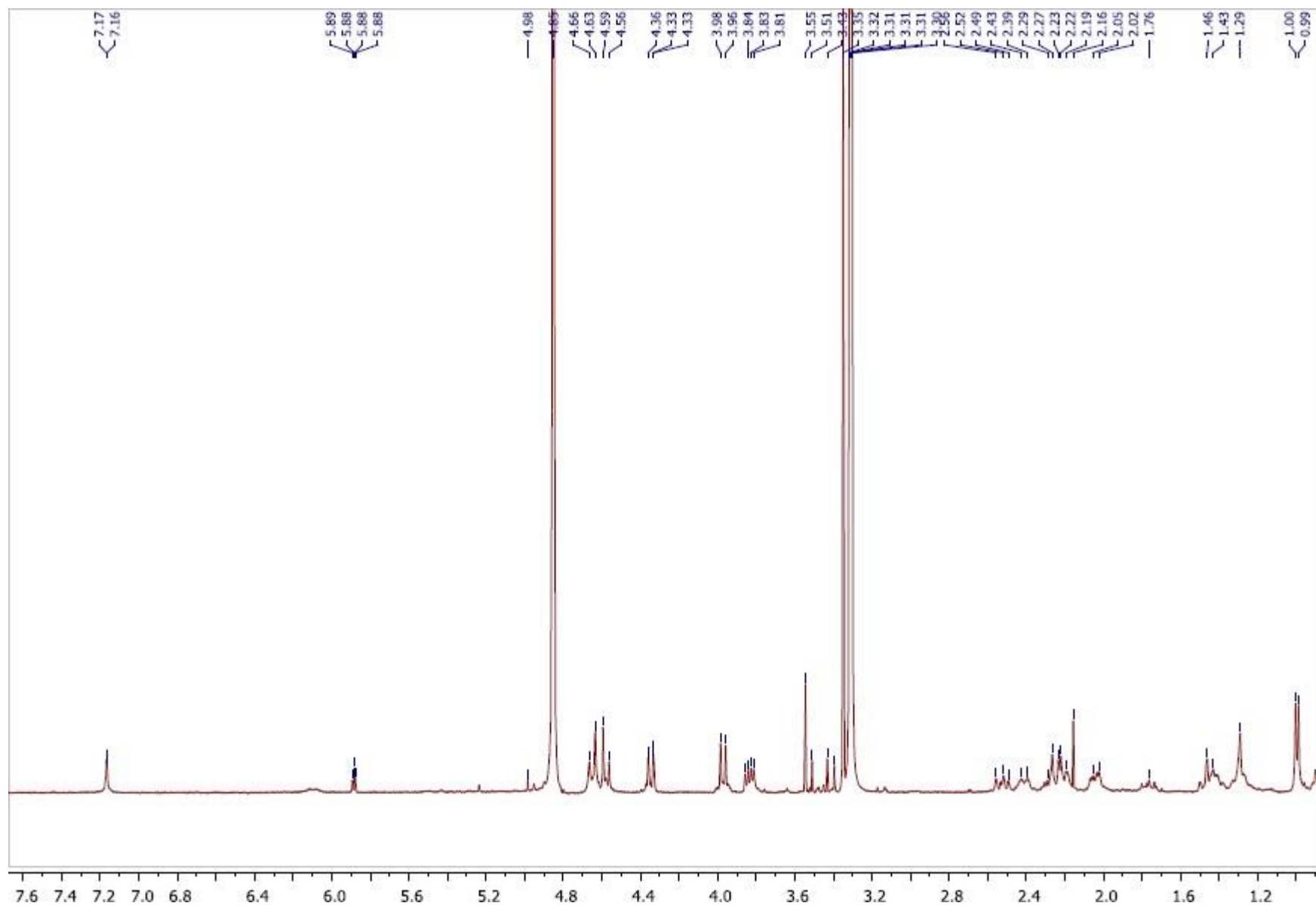
5363B35 #190-873 RT: 2.68-11.85 AV: 342 NL: 9.78E5  
F: FTMS + p ESI Full ms [100.0000-2000.0000]



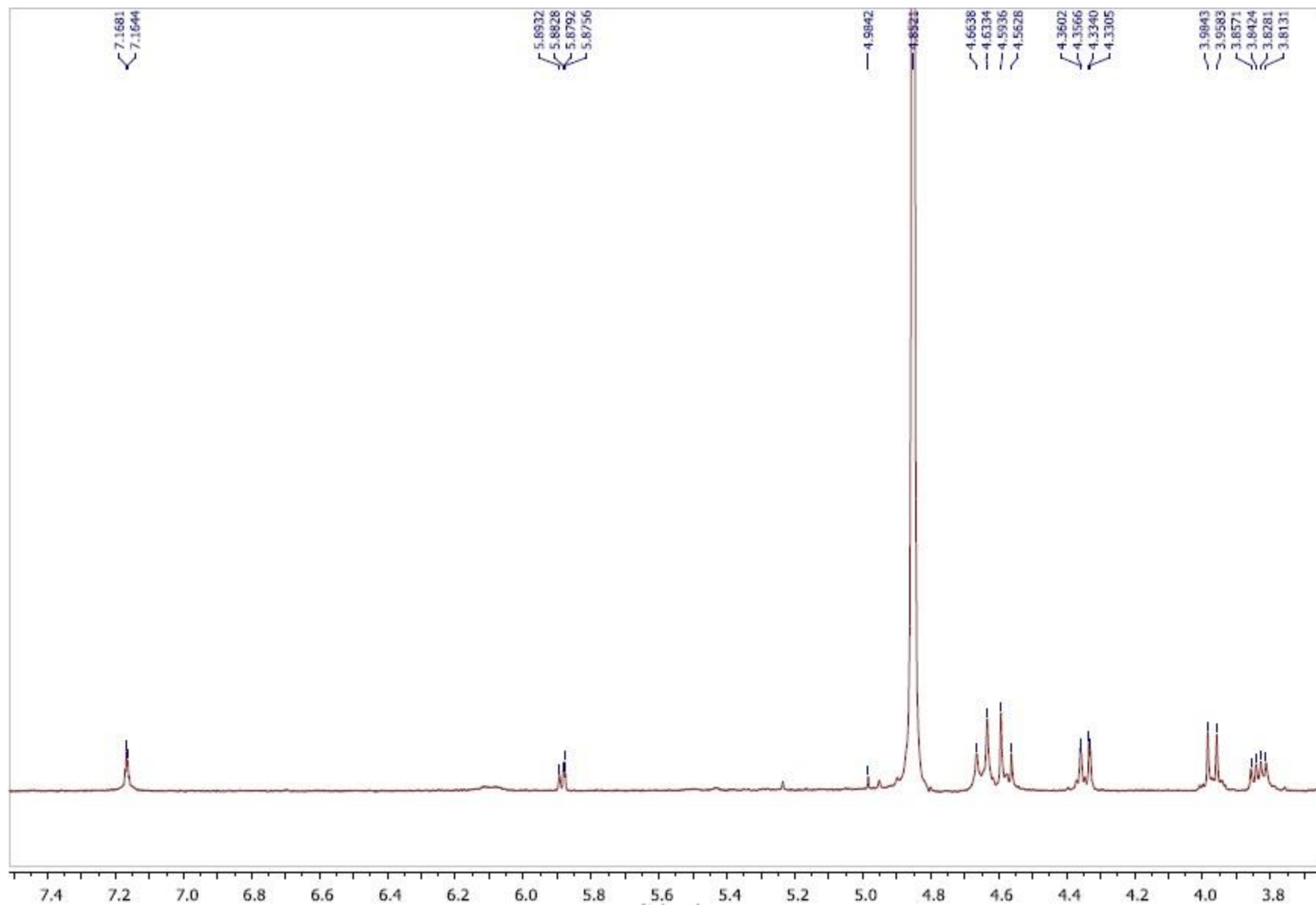
**Figure S52.** Positive-ion HRESIMS of **6**.



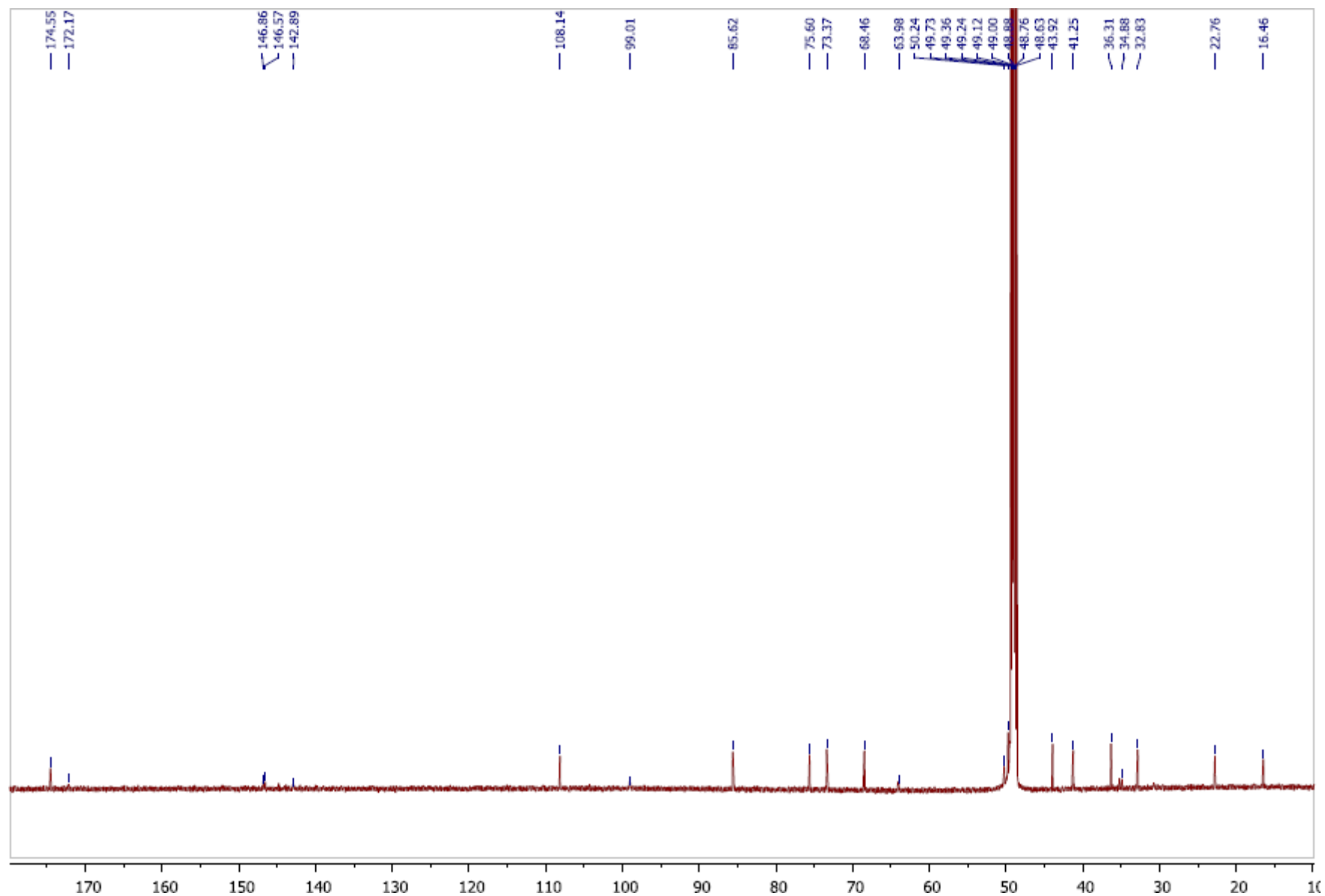
**Figure S53.**  $^1\text{H}$  NMR spectrum of **7** in  $\text{CD}_3\text{OD}$ .



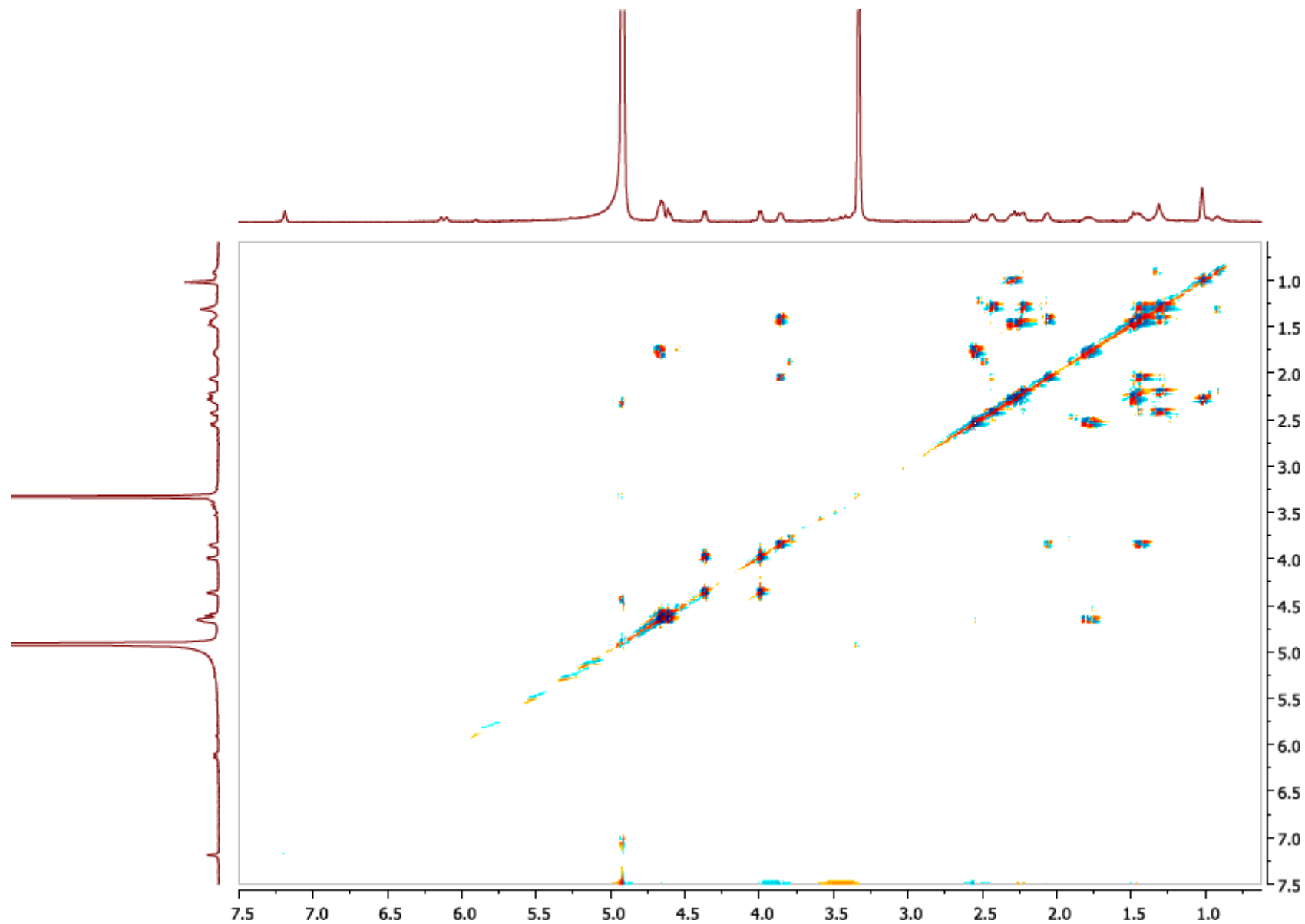
**Figure S54.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.7 –  $\delta$  2.8) of **7** in  $\text{CD}_3\text{OD}$ .



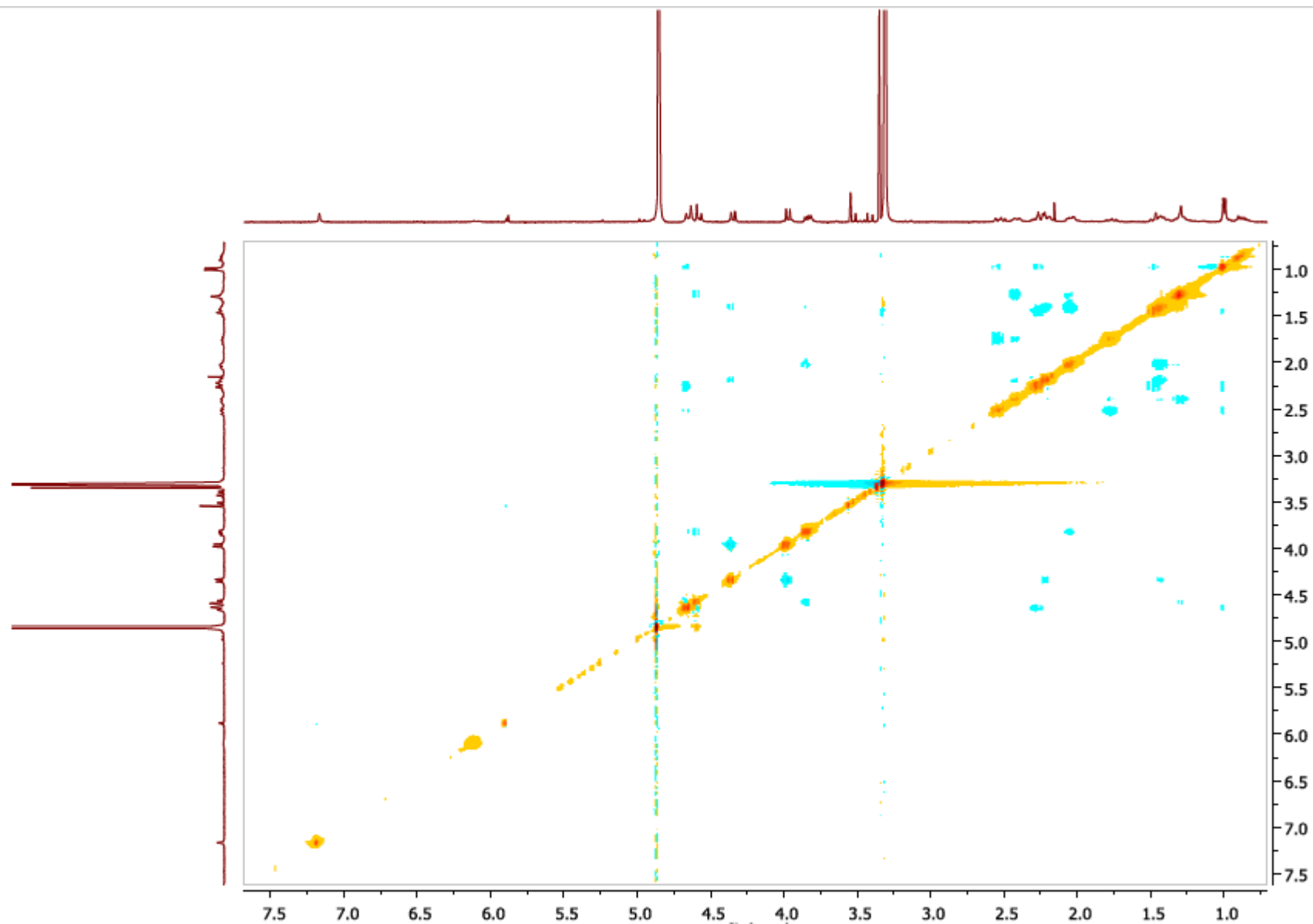
**Figure S55.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  3.7 –  $\delta$  7.4) of **7** in  $\text{CD}_3\text{OD}$ .



**Figure S56.** <sup>13</sup>C NMR spectrum of **7** in CD<sub>3</sub>OD.

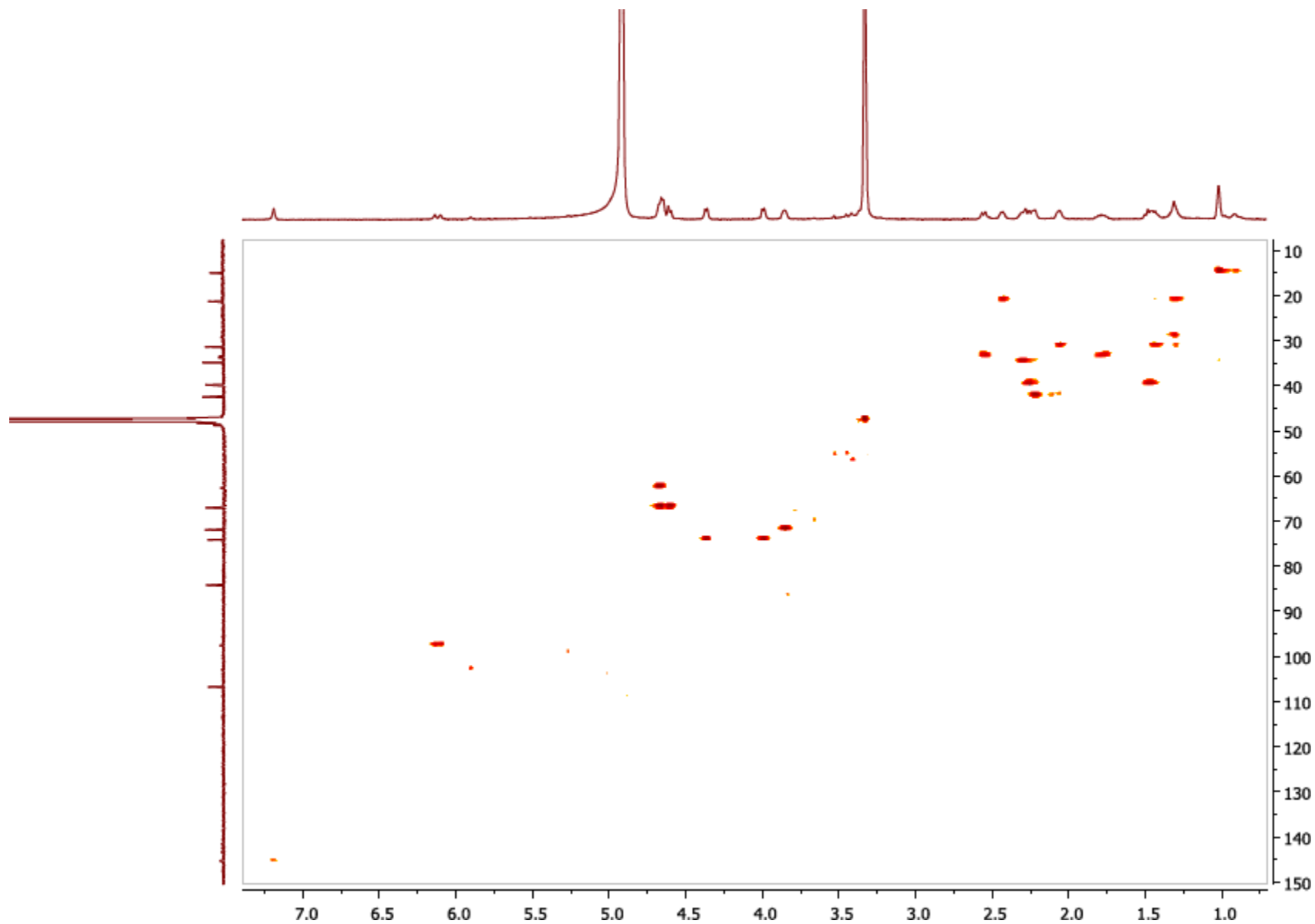


**Figure S57.** COSY NMR spectrum of **7** in CD<sub>3</sub>OD.

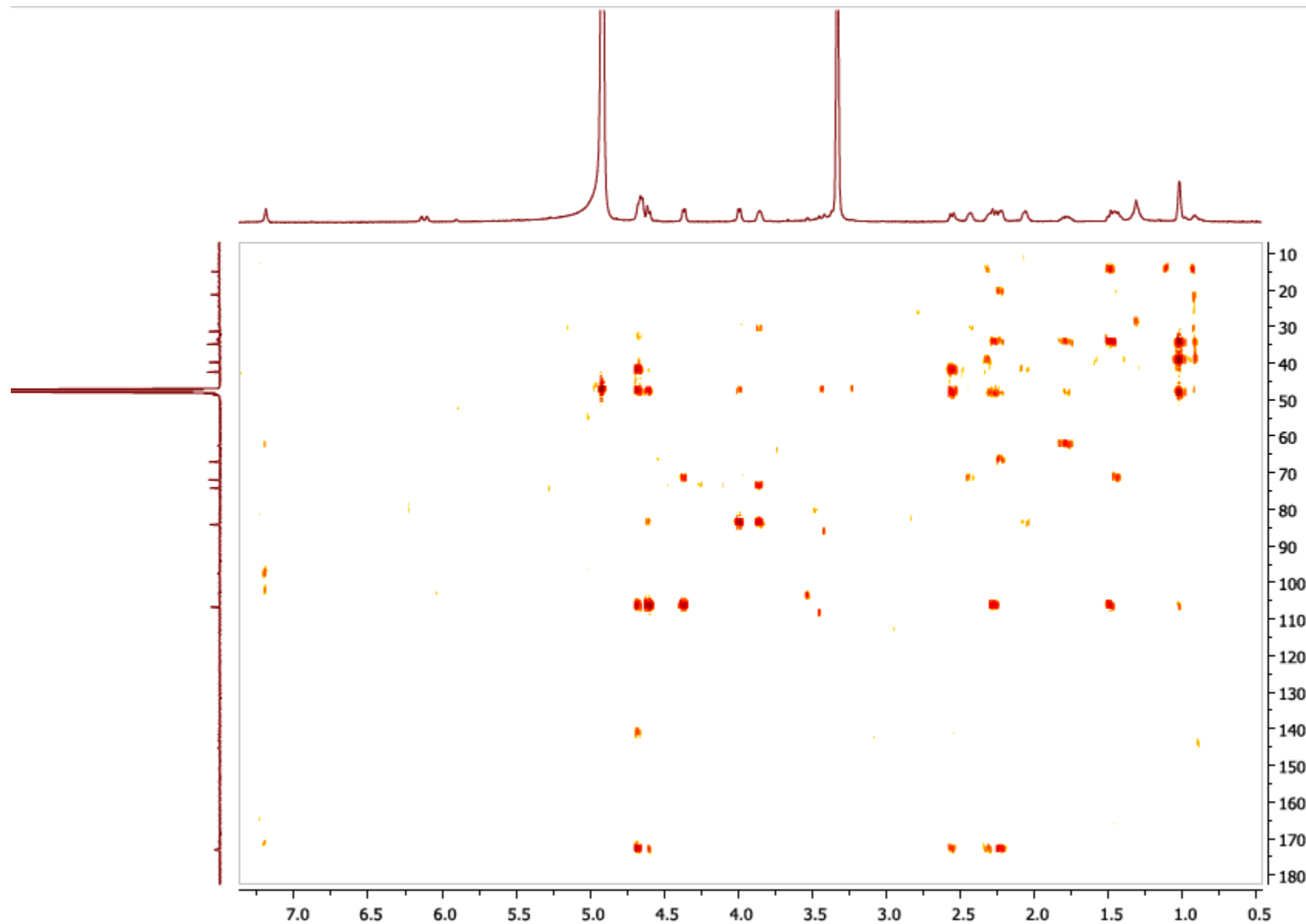


**Figure S58.** NOESY NMR spectrum of **7** in CD<sub>3</sub>OD.

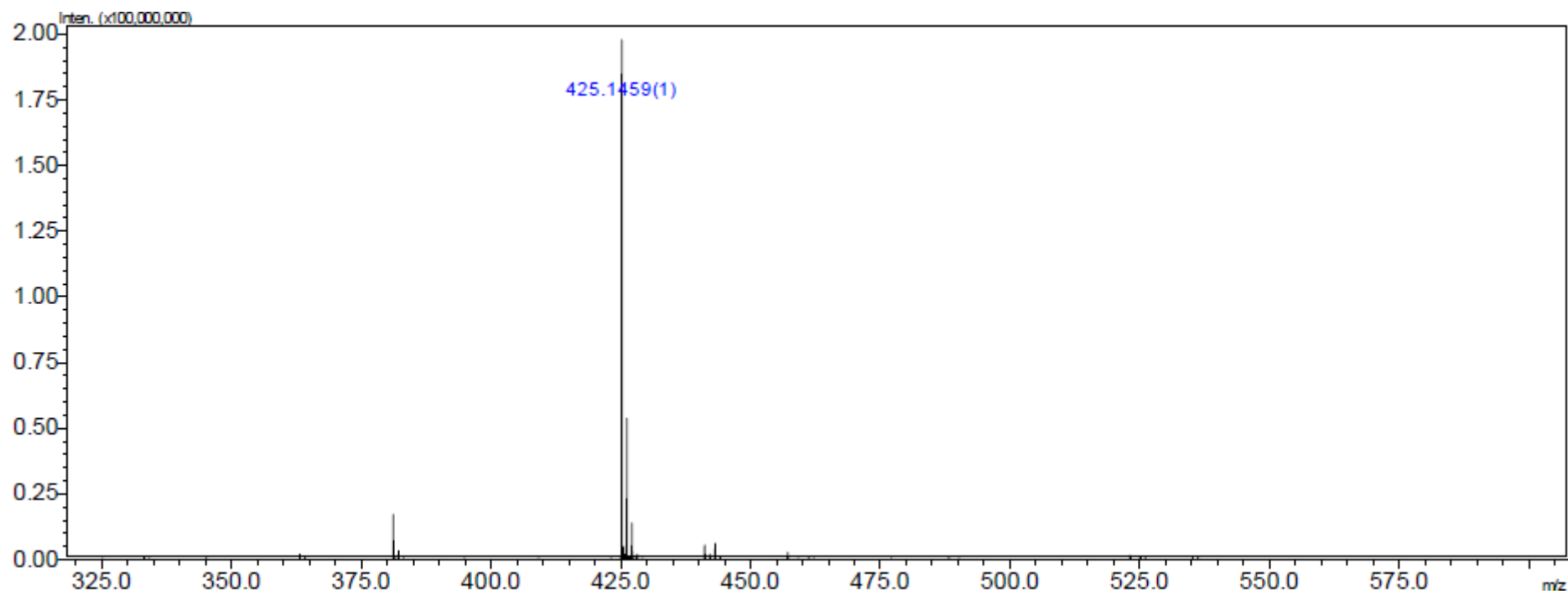




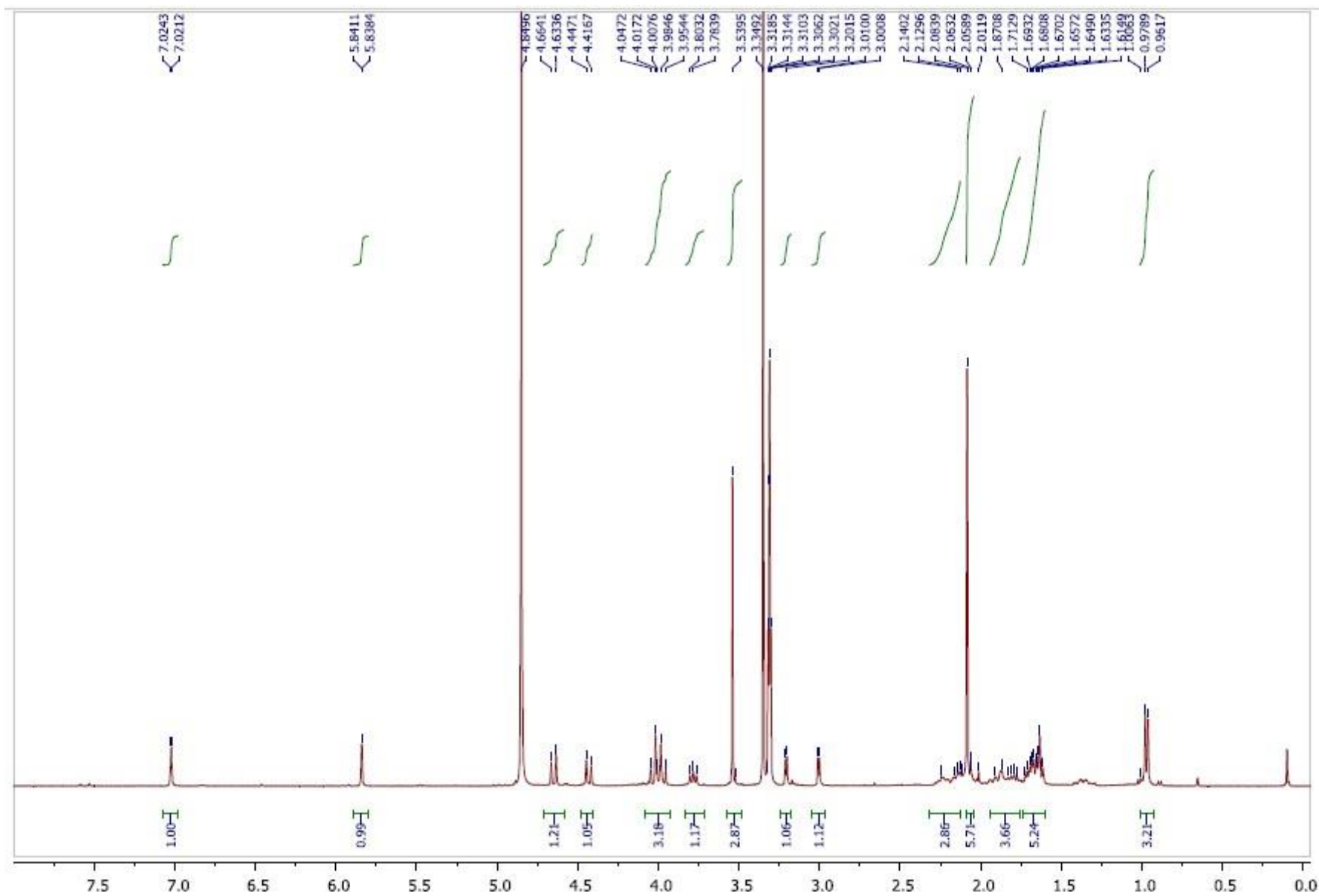
**Figure S59.** HSQC NMR spectrum of **7** in CD<sub>3</sub>OD.



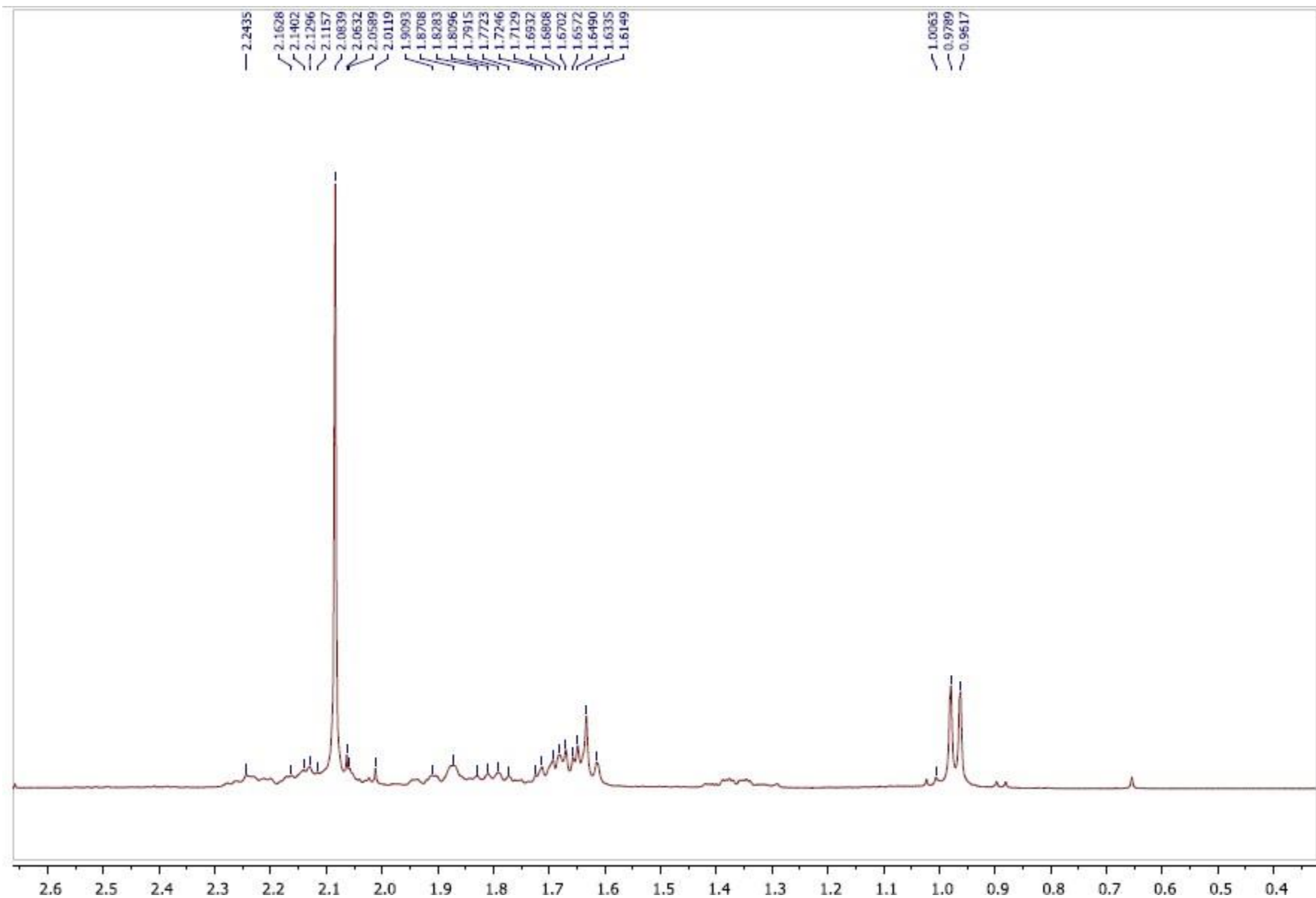
**Figure S60.** HMBC NMR spectrum of **7** in CD<sub>3</sub>OD.



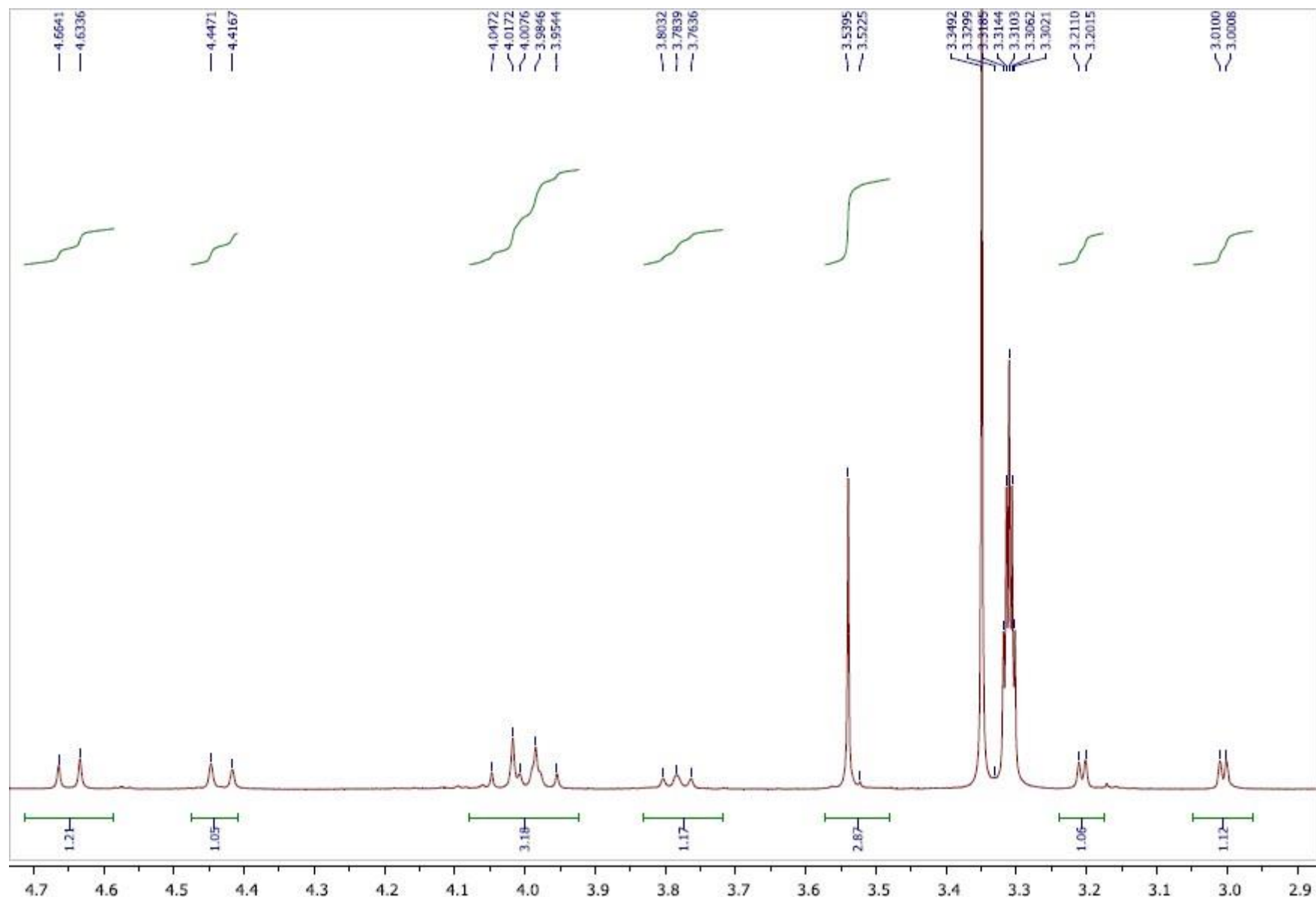
**Figure S61.** Negative-ion HRESIMS of **7**.



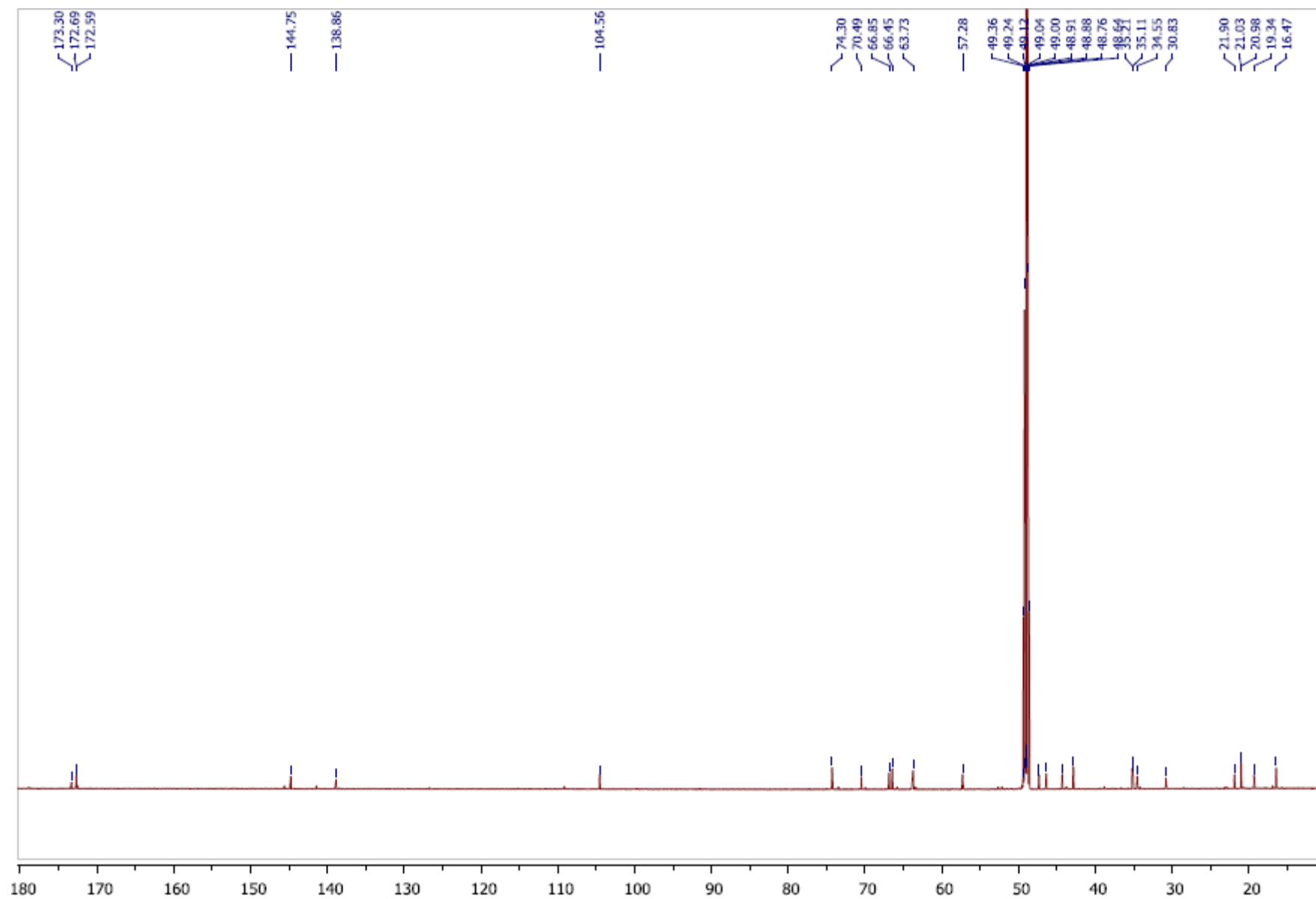
**Figure S62.** <sup>1</sup>H NMR spectrum of **8** in CD<sub>3</sub>OD.



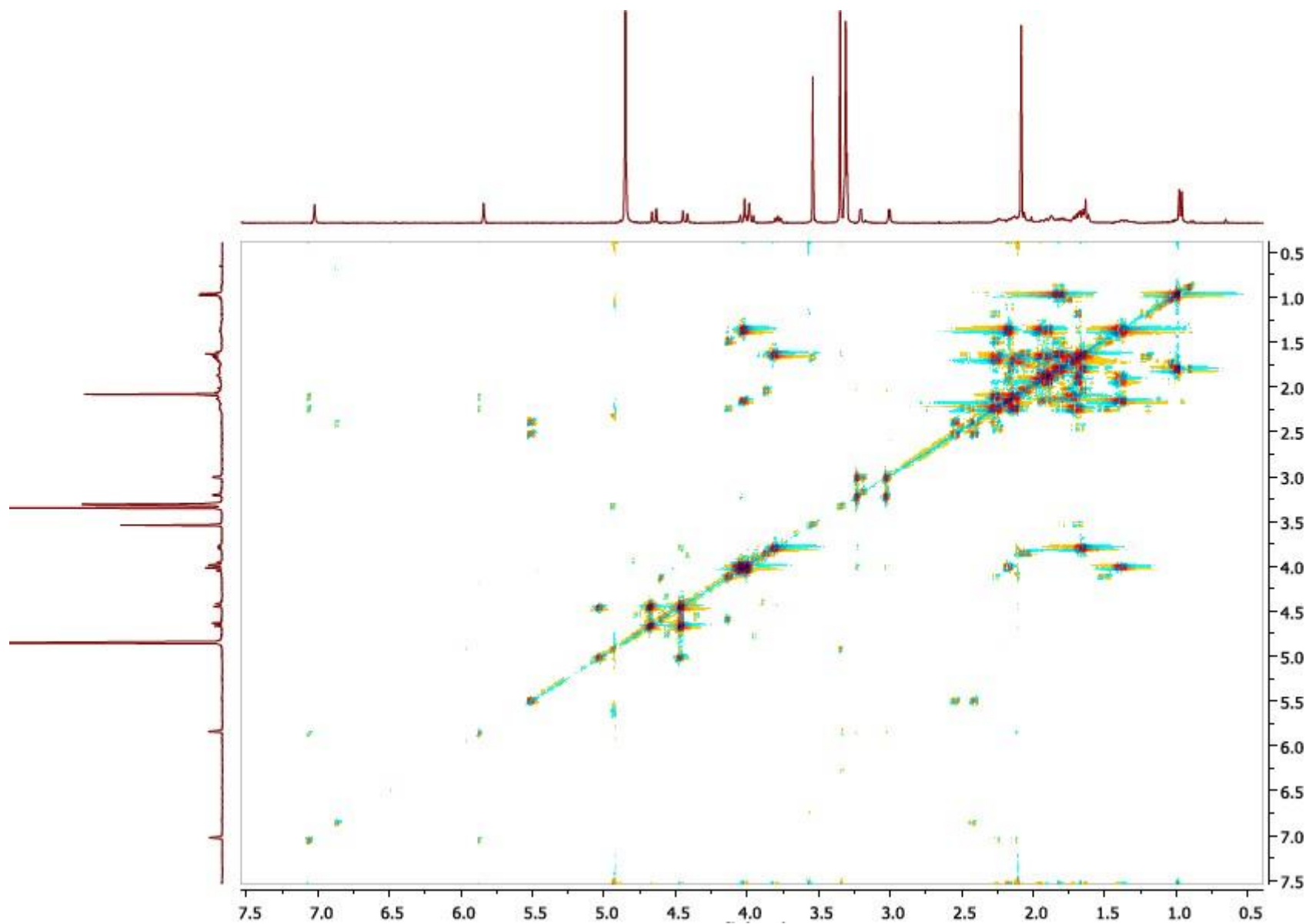
**Figure S63.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.4 –  $\delta$  2.6) of **8** in  $\text{CD}_3\text{OD}$ .



**Figure S64.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  2.9 –  $\delta$  4.7) of **8** in  $\text{CD}_3\text{OD}$ .

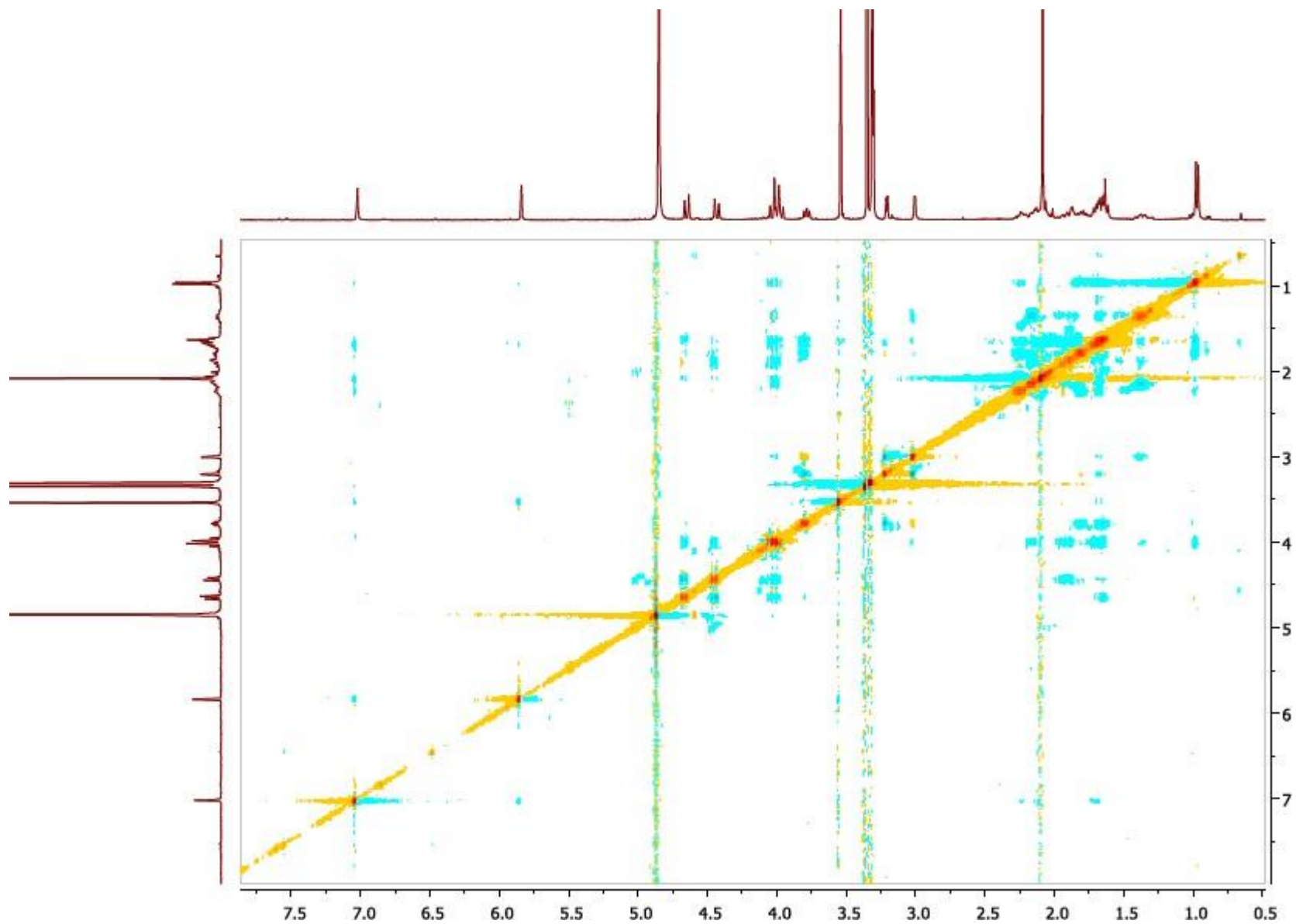


**Figure S65.** <sup>13</sup>C NMR spectrum of **8** in CD<sub>3</sub>OD.

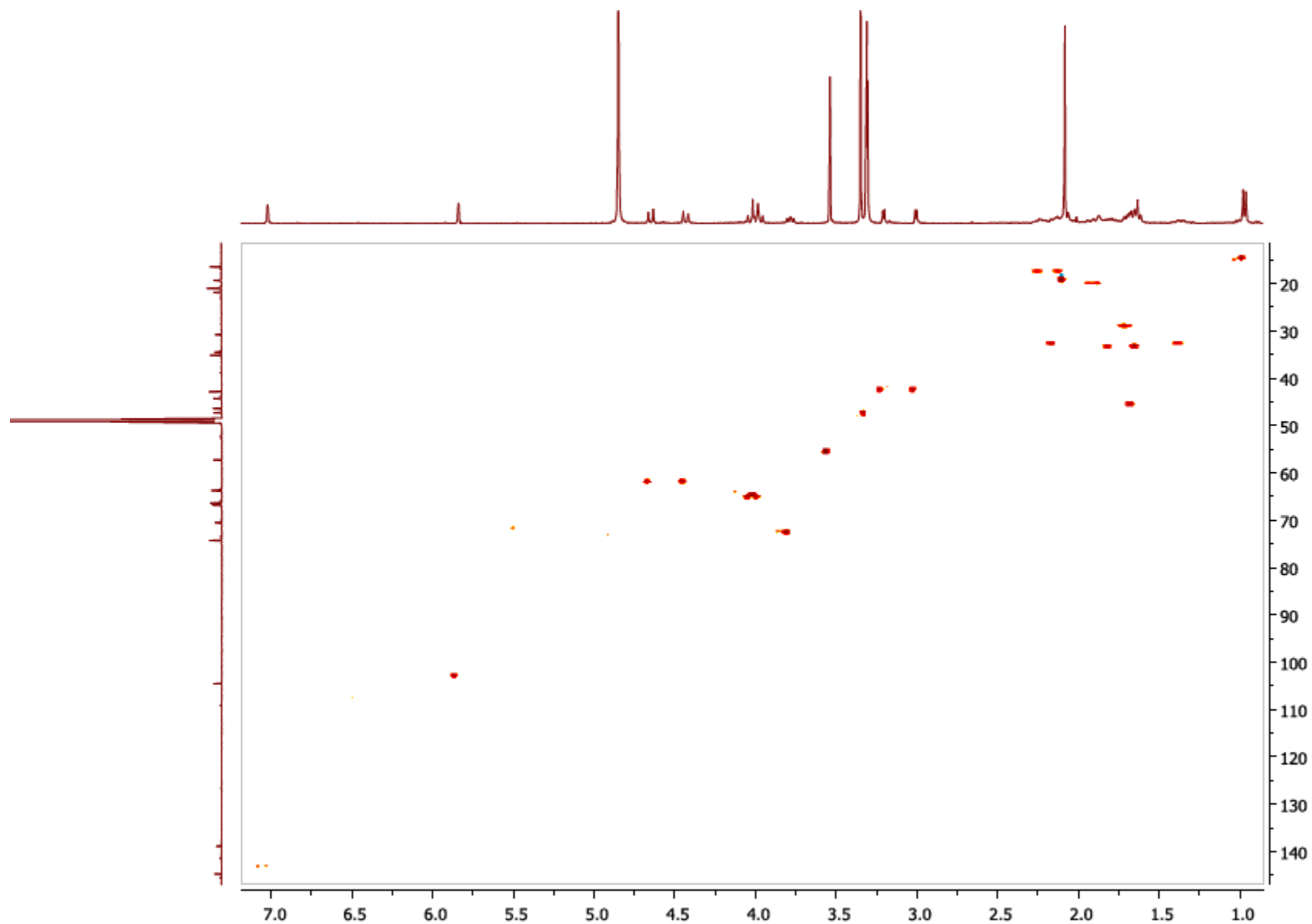


**Figure S66.** COSY NMR spectrum of **8** in  $\text{CD}_3\text{OD}$ .

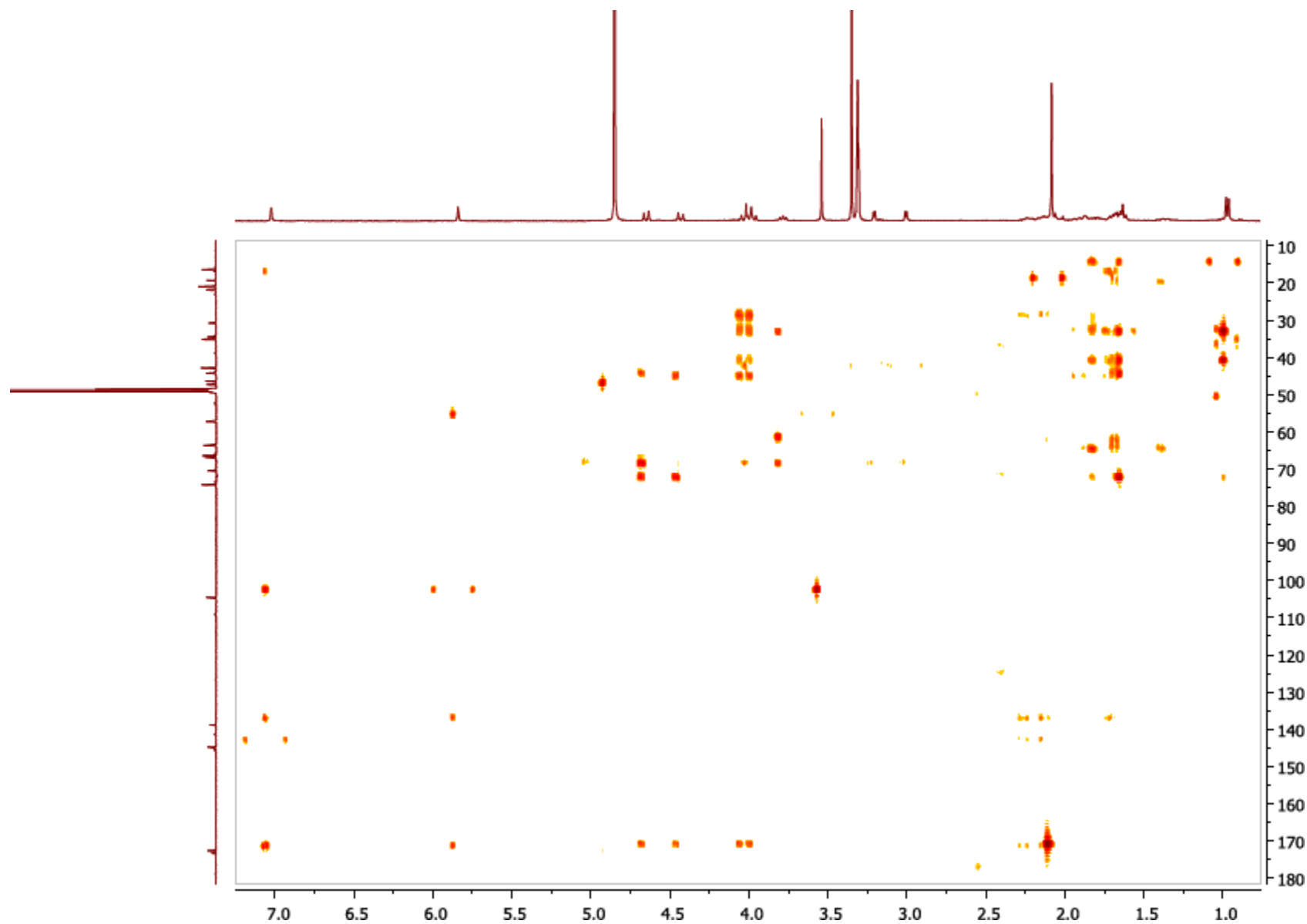




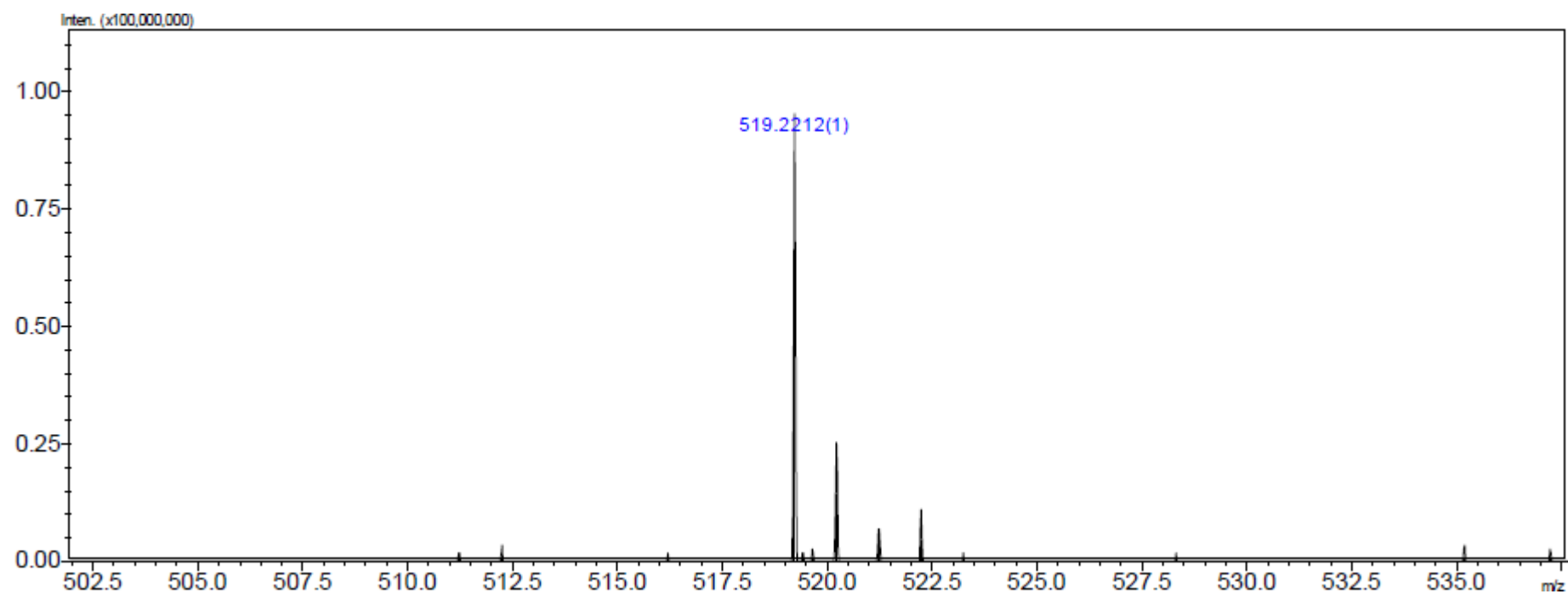
**Figure S67.** NOESY NMR spectrum of **8** in CD<sub>3</sub>OD.



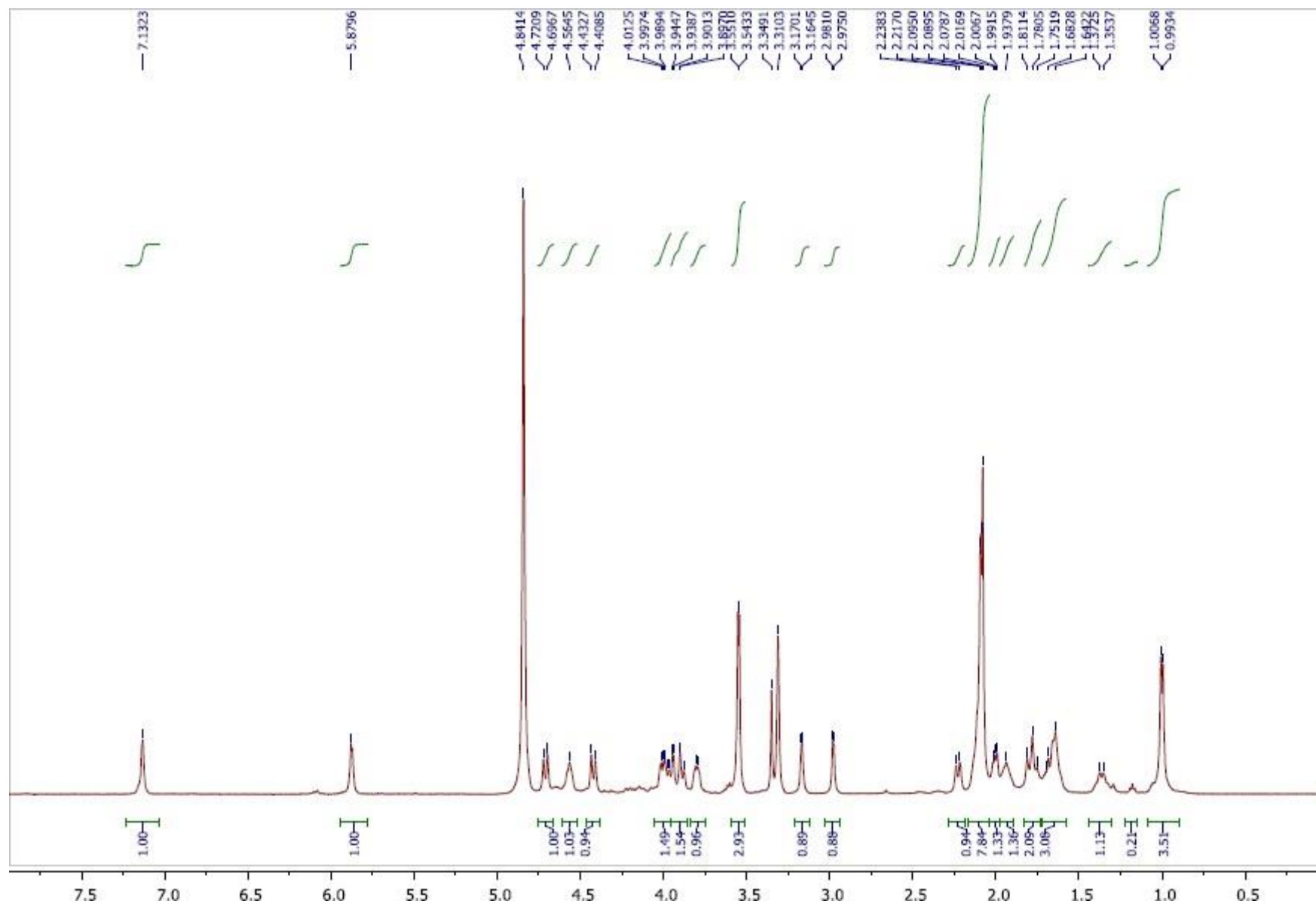
**Figure S68.** HSQC NMR spectrum of **8** in CD<sub>3</sub>OD.



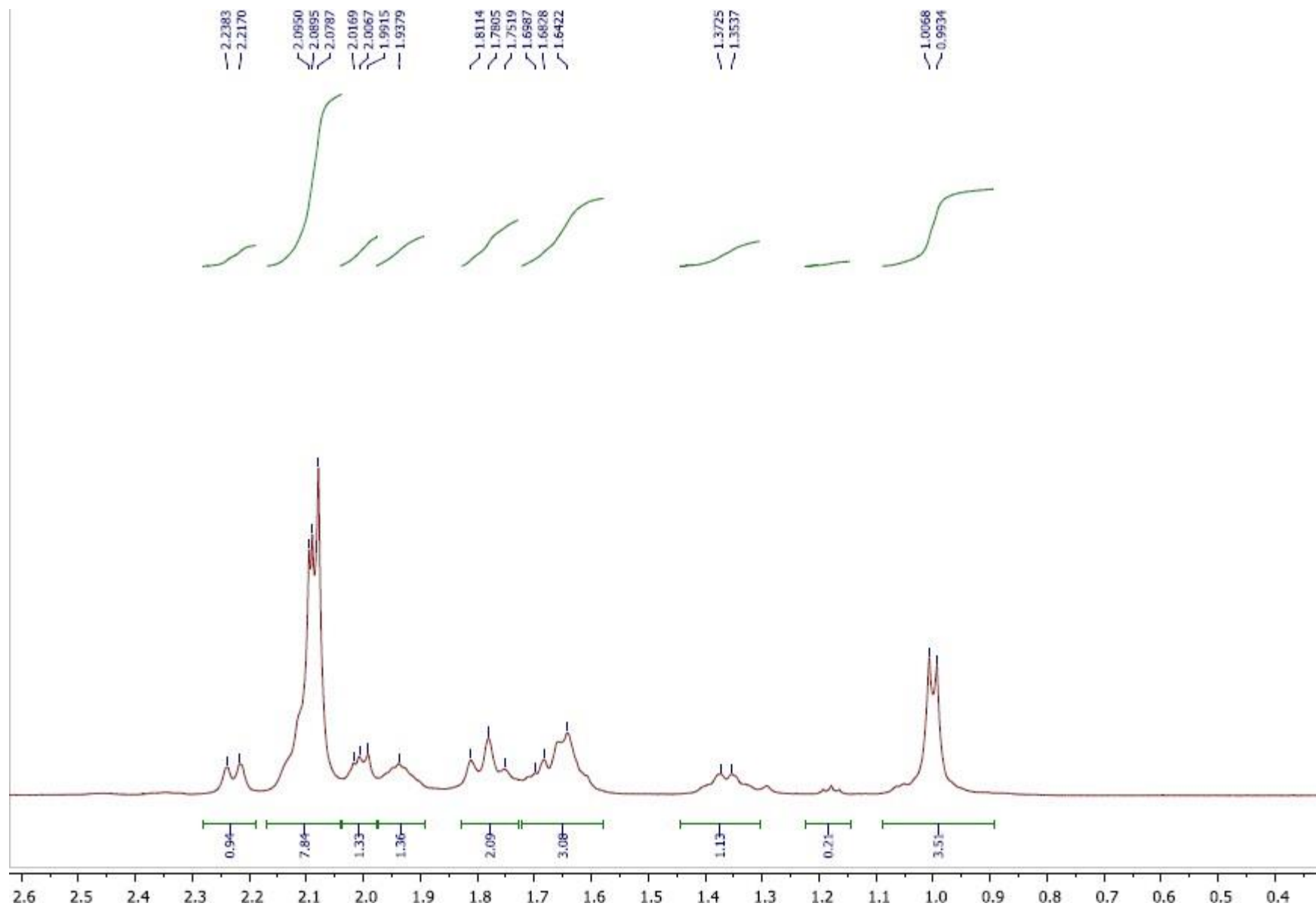
**Figure S69.** HMBC NMR spectrum of **8** in CD<sub>3</sub>OD.



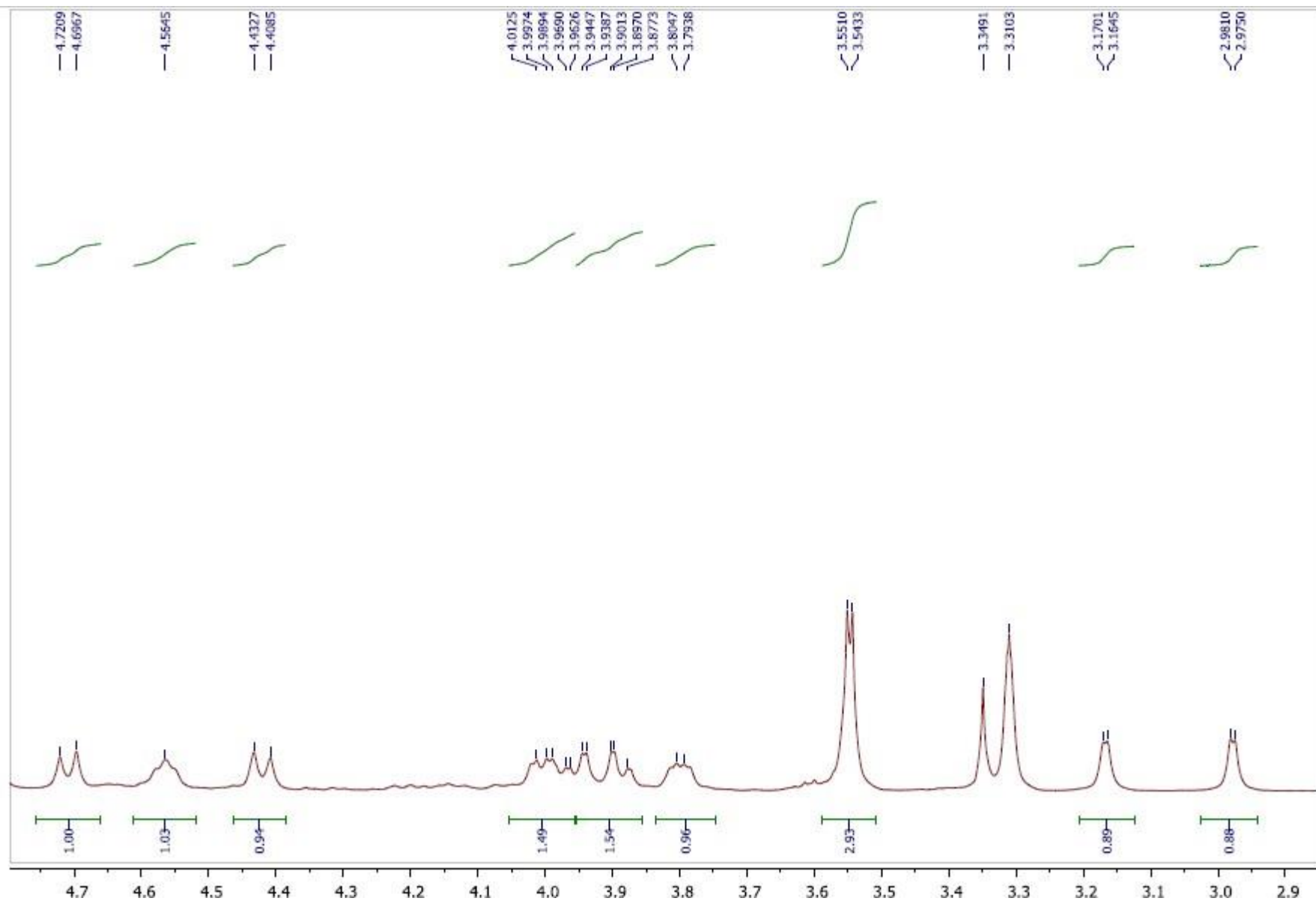
**Figure S70.** Positive-ion HRESIMS of **8**.



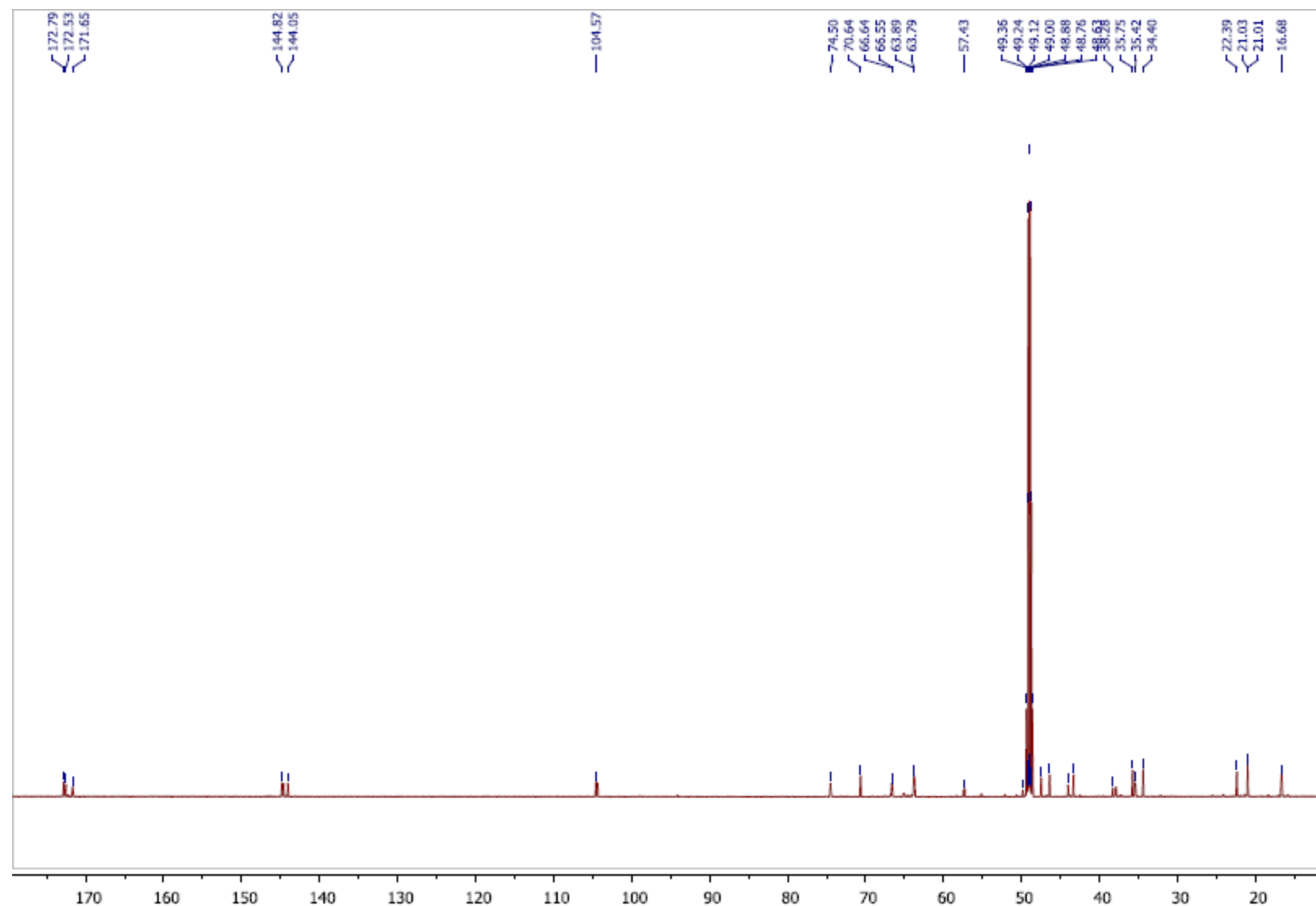
**Figure S71.**  $^1\text{H}$  NMR spectrum of **9** in  $\text{CD}_3\text{OD}$ .



**Figure S72.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.4 –  $\delta$  2.6) of **9** in  $\text{CD}_3\text{OD}$ .

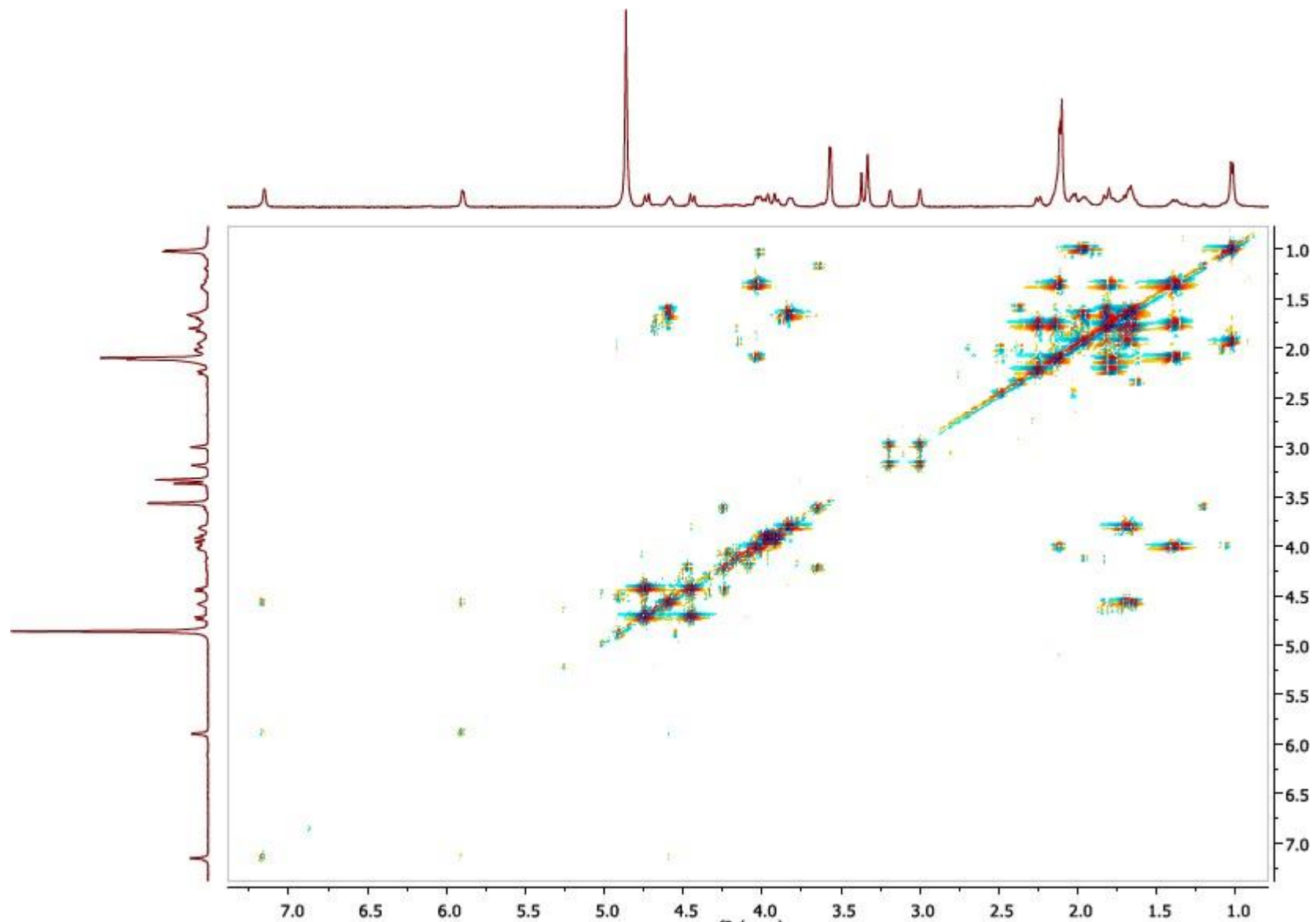


**Figure S73.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  2.9 –  $\delta$  4.8) of **9** in  $\text{CD}_3\text{OD}$ .

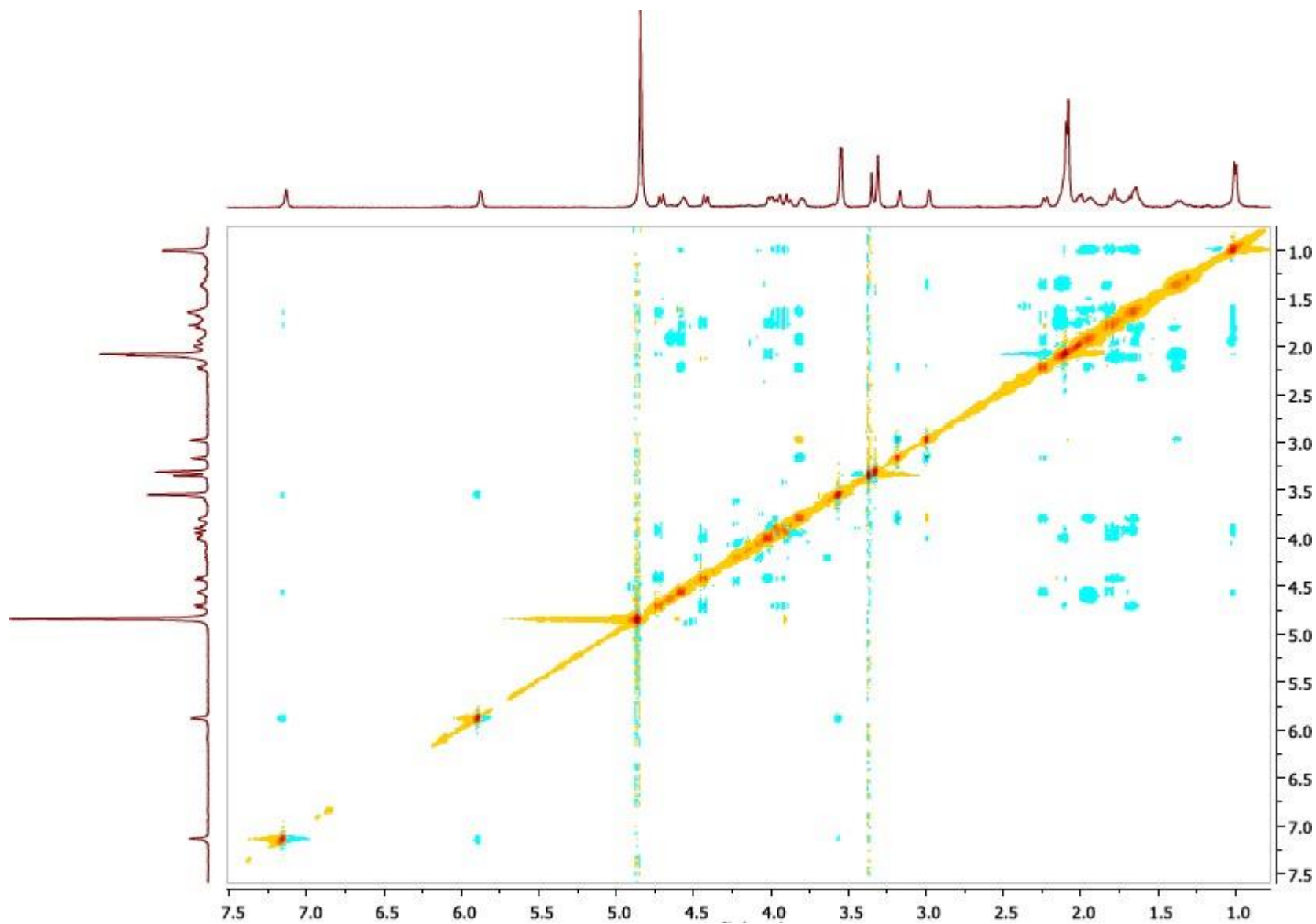


**Figure S74.** <sup>13</sup>C NMR spectrum of **9** in CD<sub>3</sub>OD.

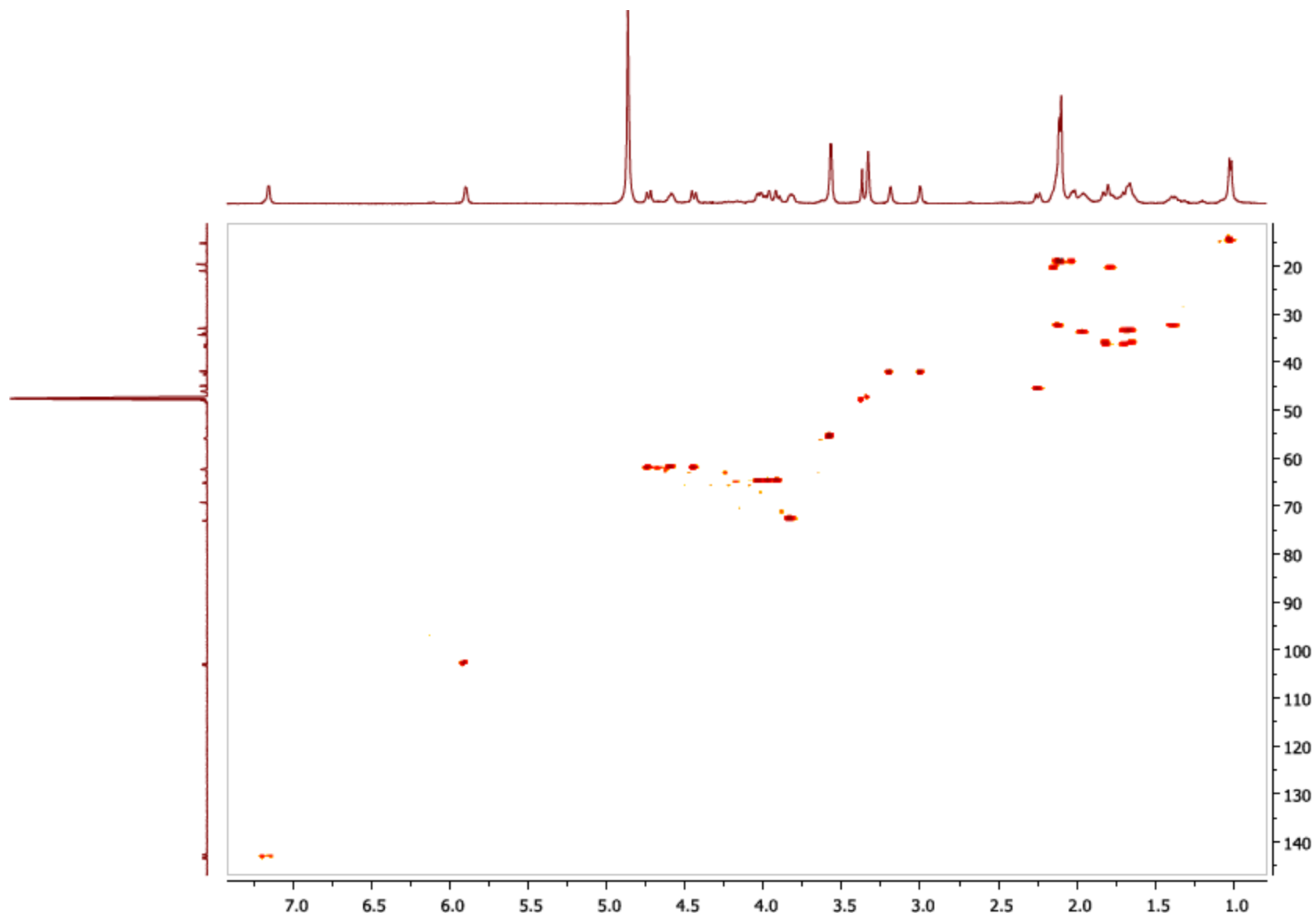




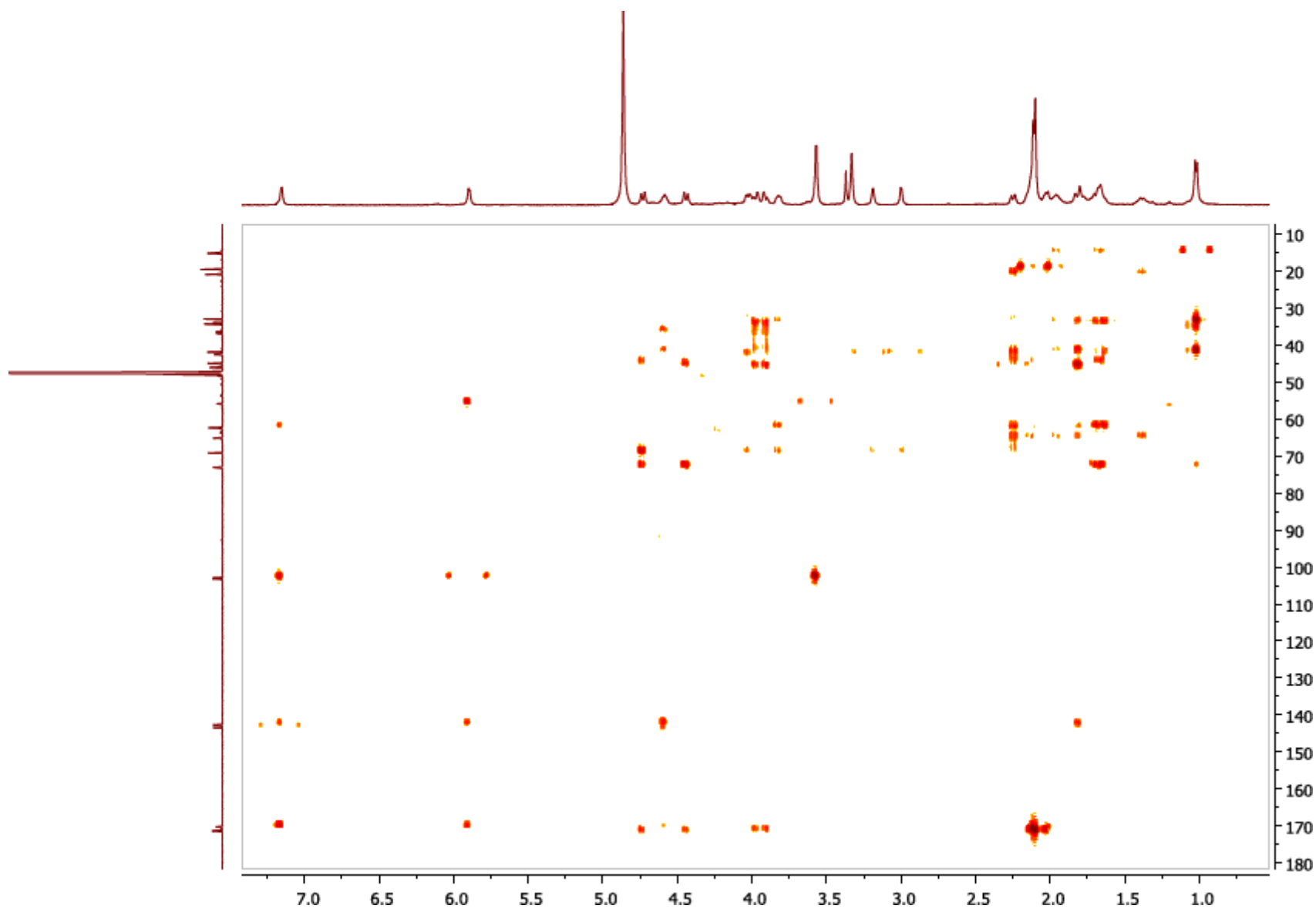
**Figure S75.** COSY NMR spectrum of **9** in CD<sub>3</sub>OD.



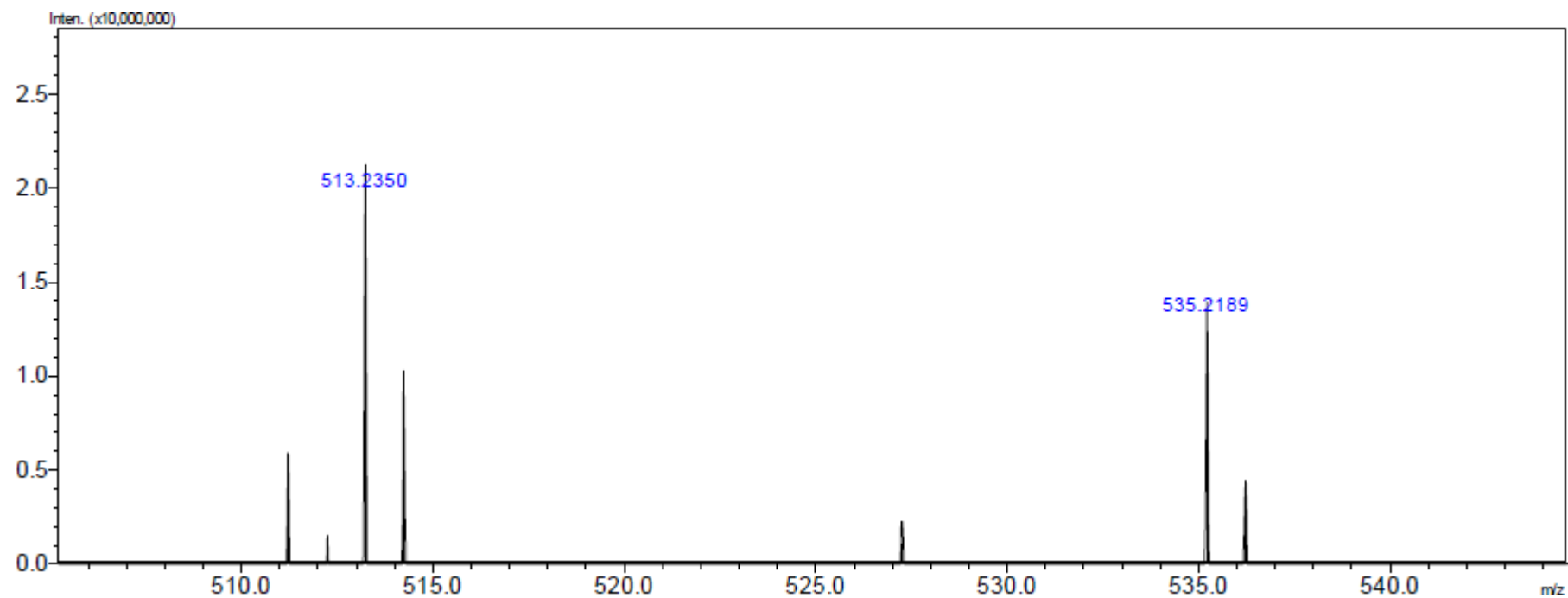
**Figure S76.** NOESY NMR spectrum of **9** in  $\text{CD}_3\text{OD}$ .



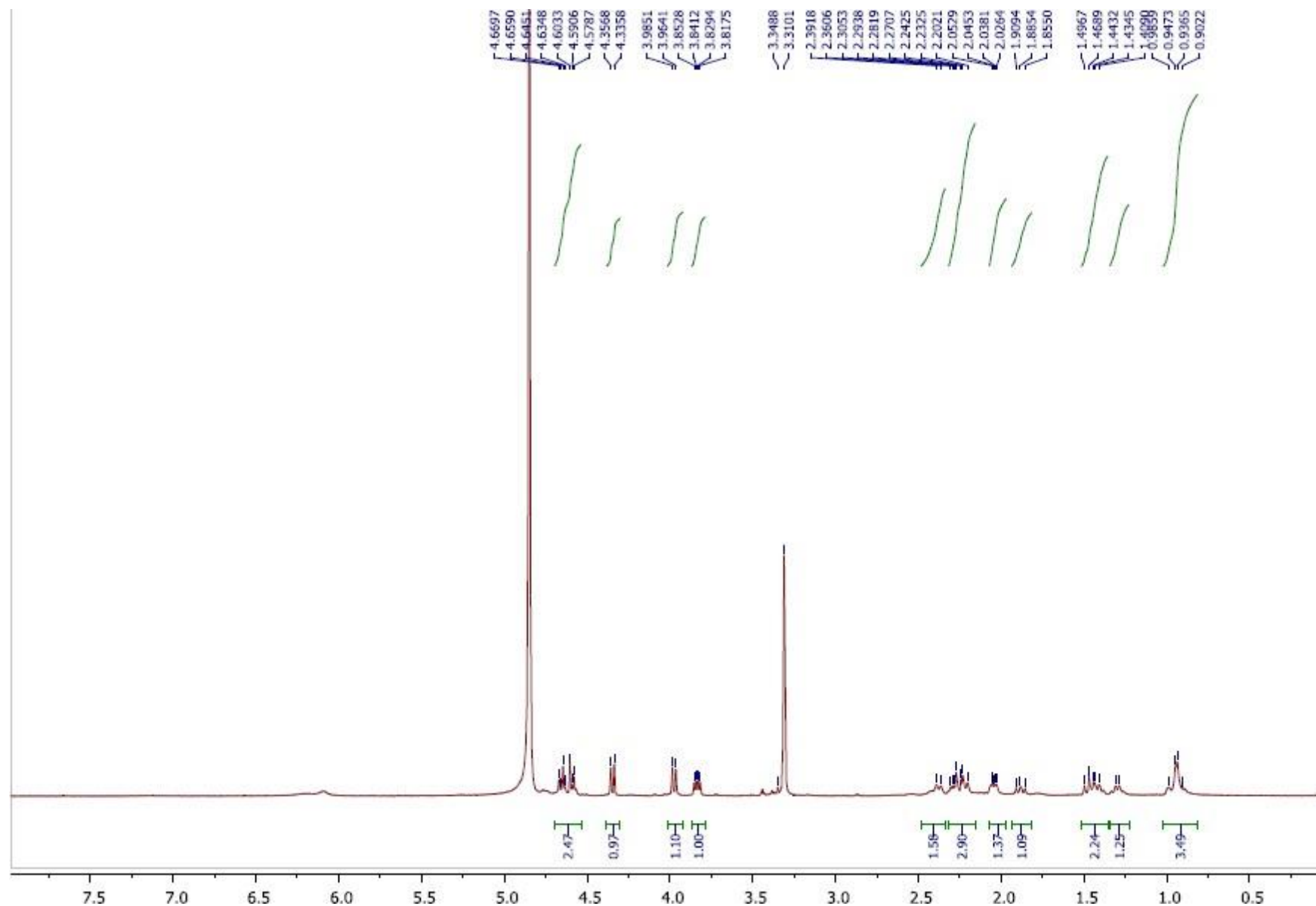
**Figure S77.** HSQC NMR spectrum of **9** in CD<sub>3</sub>OD.



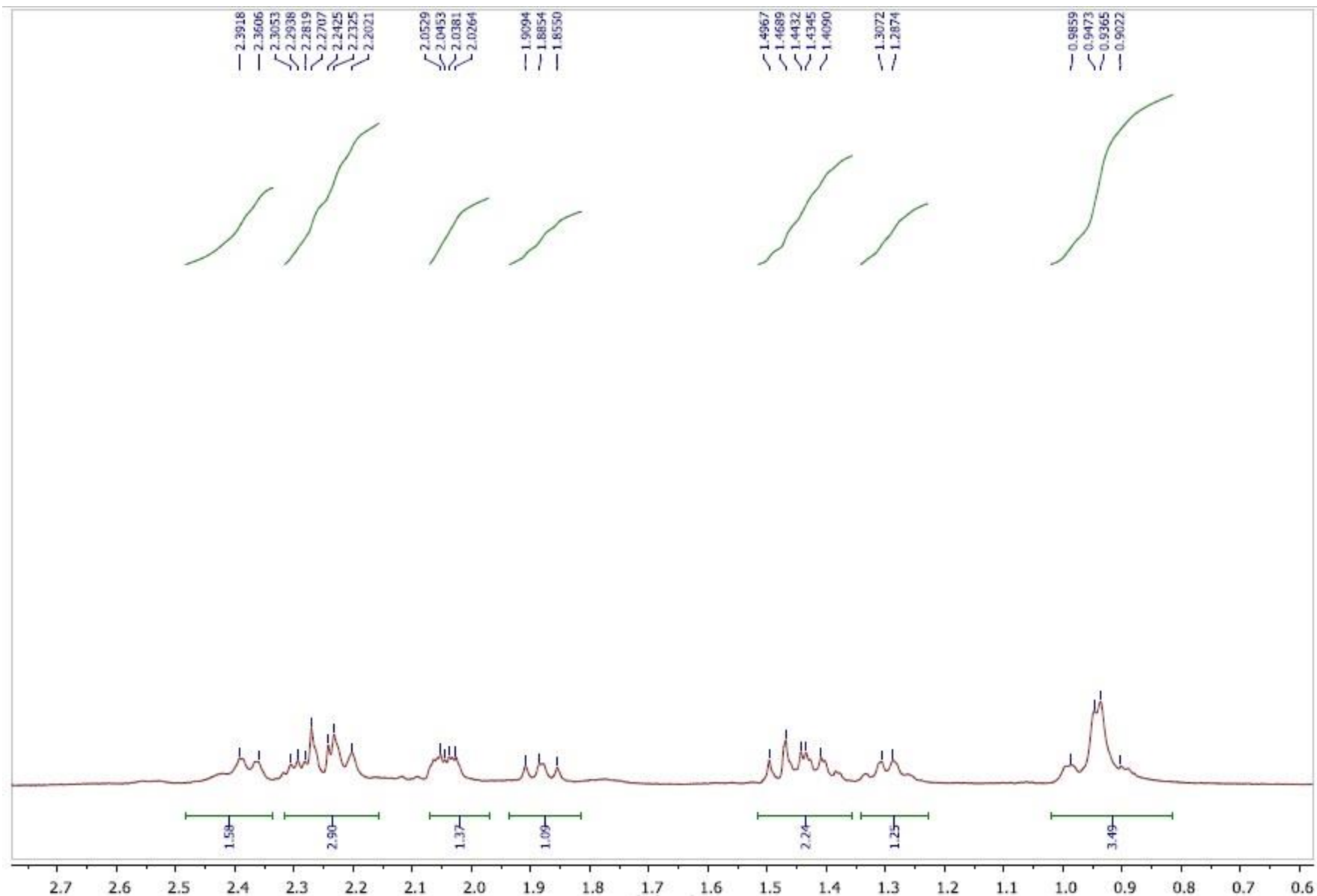
**Figure S78.** HMBC NMR spectrum of **9** in CD<sub>3</sub>OD.



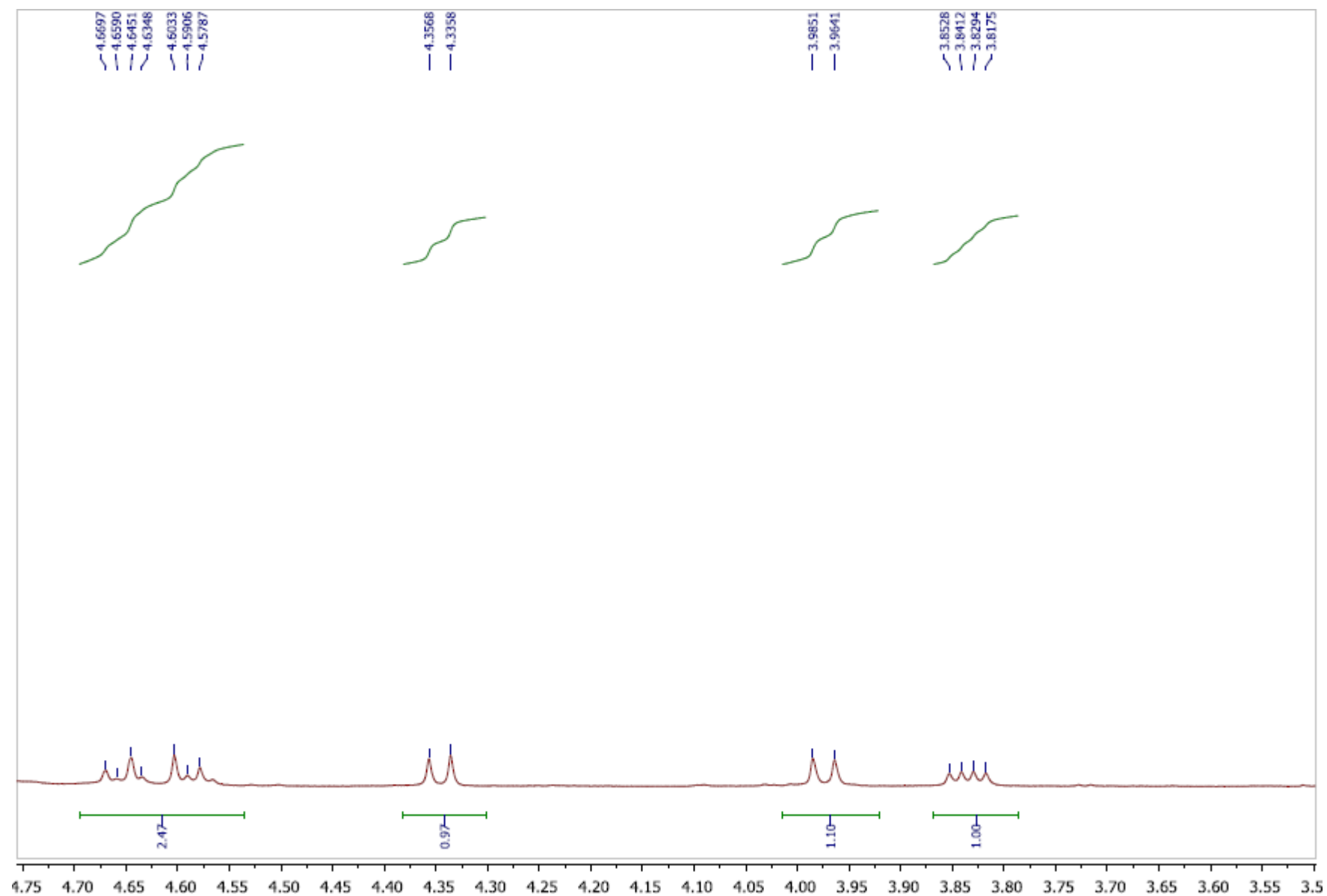
**Figure S79.** Positive-ion HRESIMS of **9**.



**Figure S80.**  $^1\text{H}$  NMR spectrum of **10** in  $\text{CD}_3\text{OD}$ .

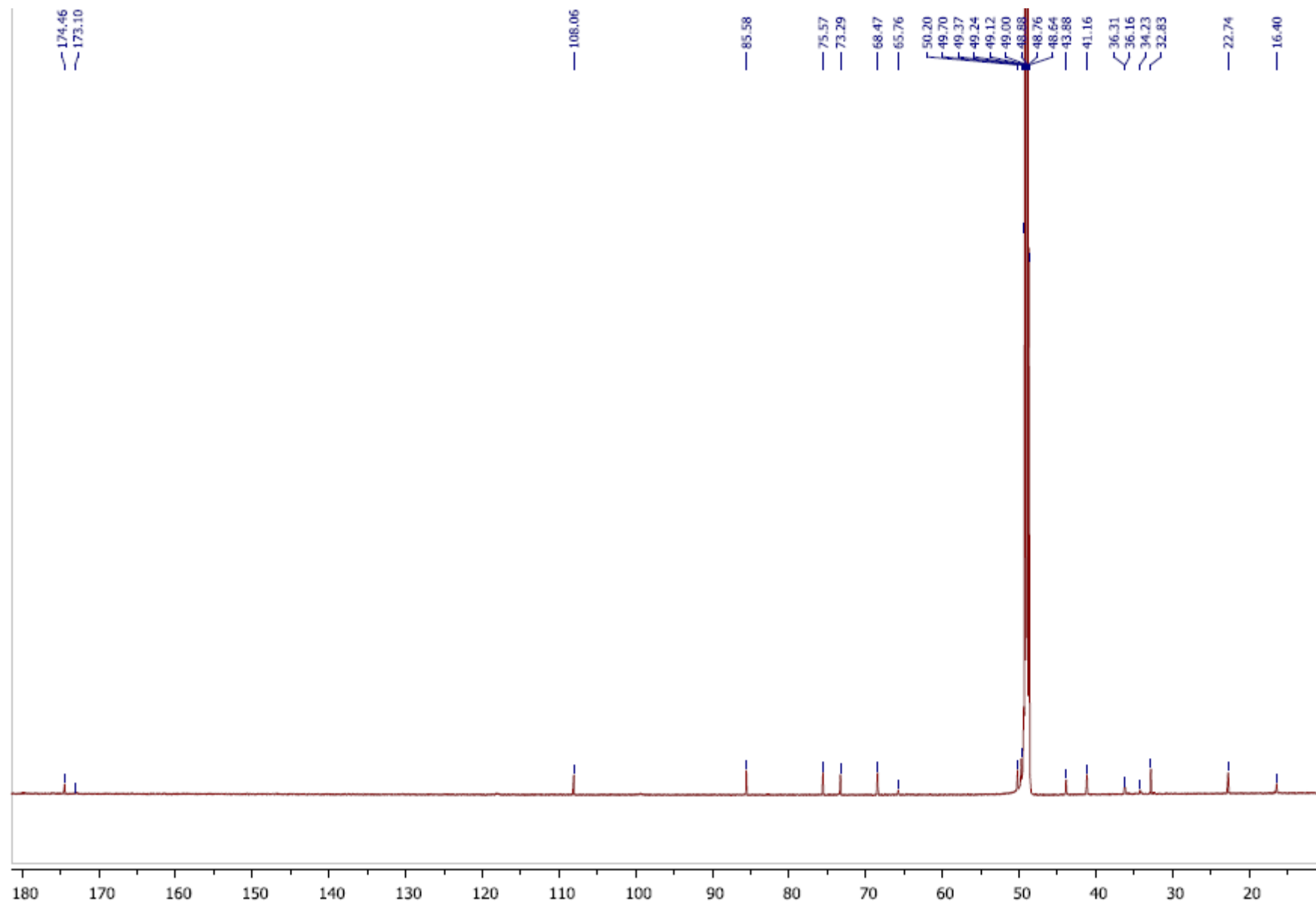


**Figure S81.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.6 –  $\delta$  2.7) of **10** in  $\text{CD}_3\text{OD}$ .

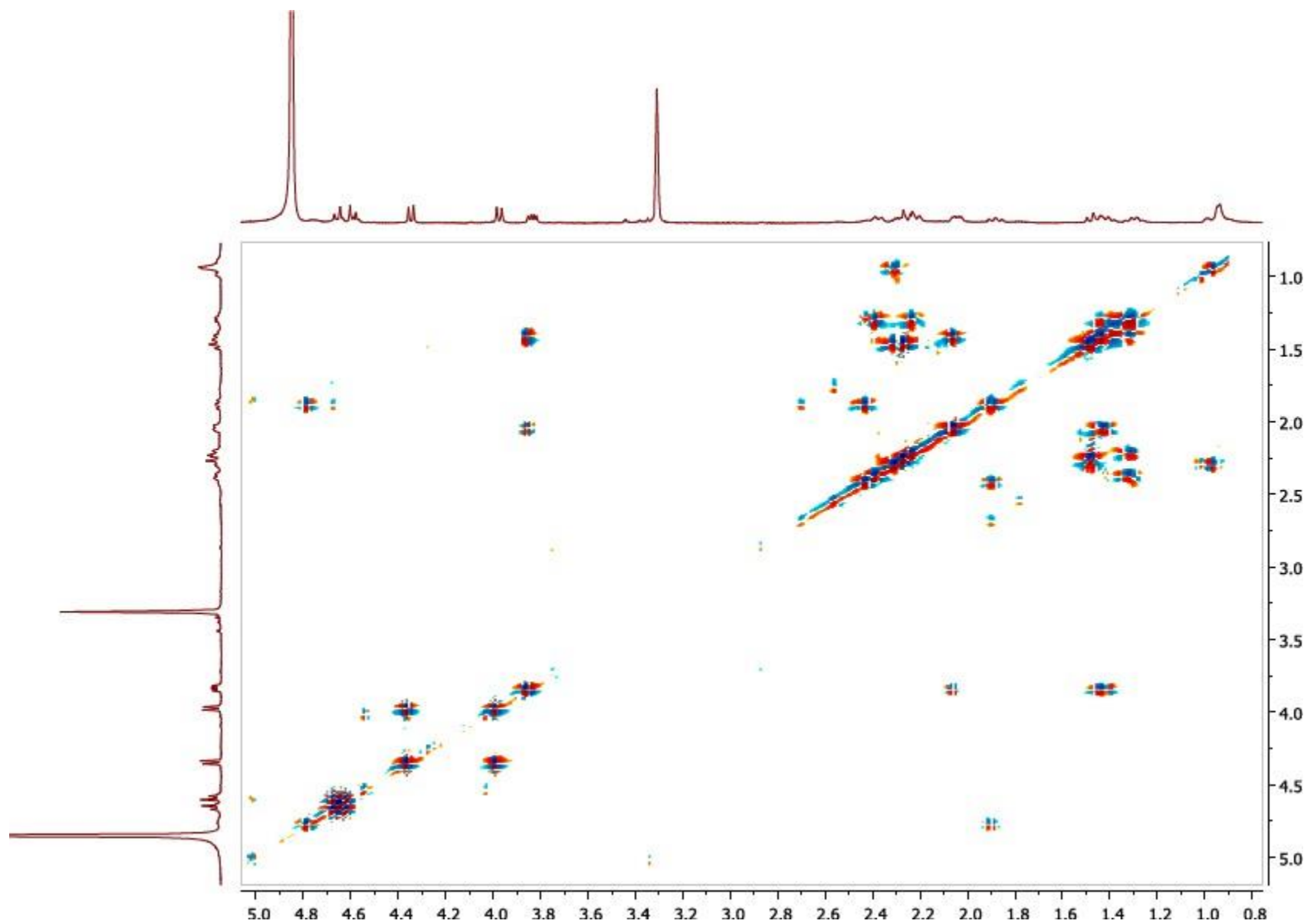


**Figure S82.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  3.5 –  $\delta$  4.7) of **10** in  $\text{CD}_3\text{OD}$ .

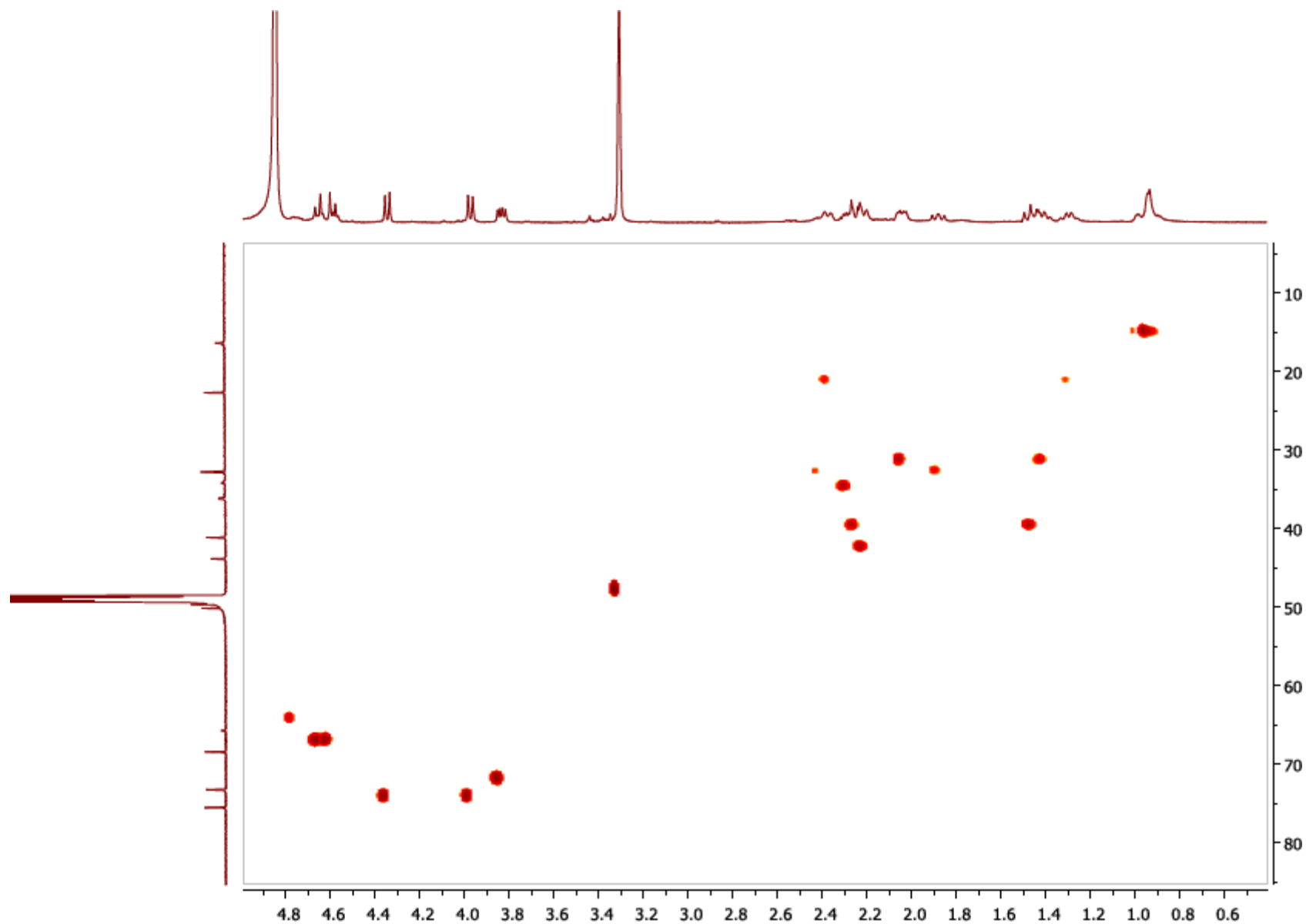




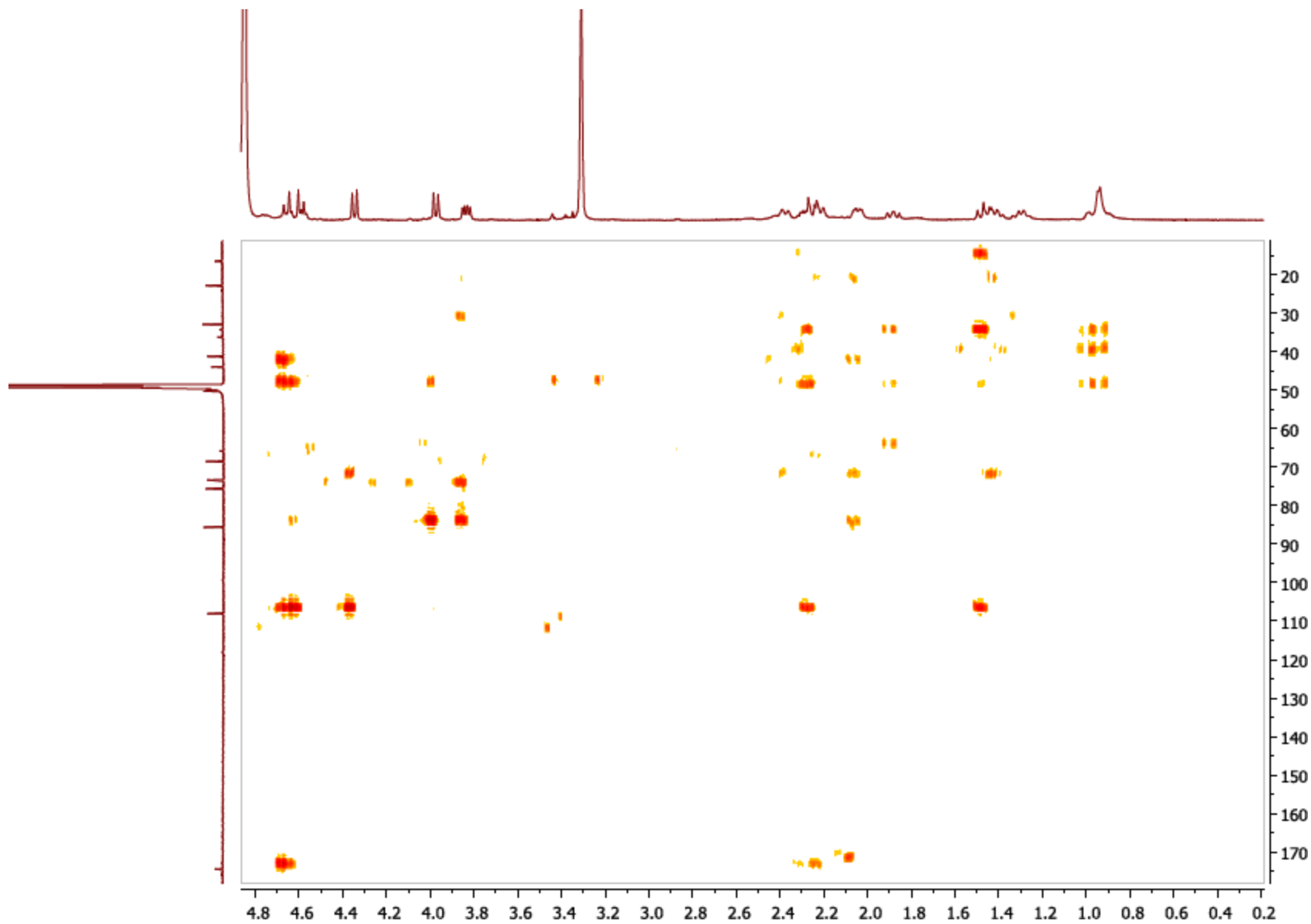
**Figure S83.** <sup>13</sup>C NMR spectrum of **10** in CD<sub>3</sub>OD.



**Figure S84.** COSY NMR spectrum of **10** in CD<sub>3</sub>OD.

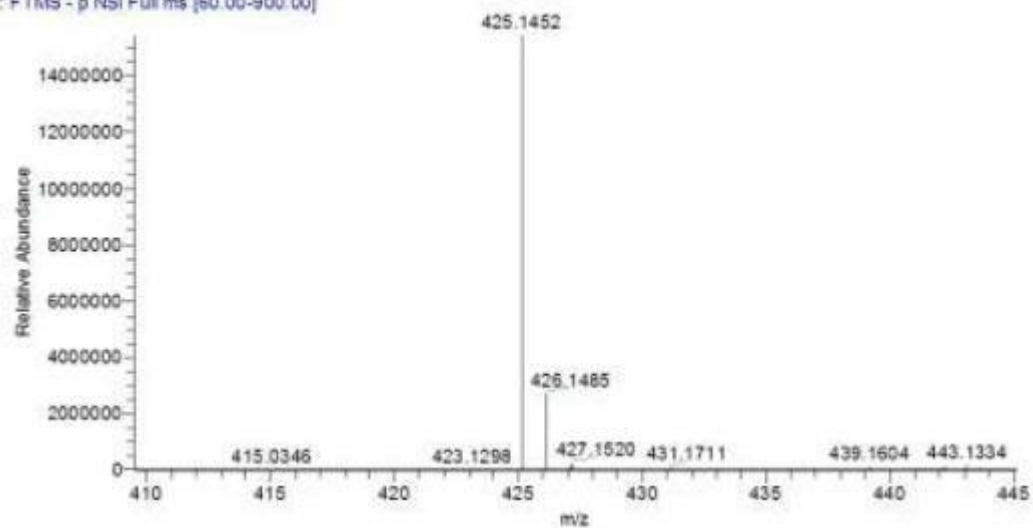


**Figure S85.** HSQC NMR spectrum of **10** in CD<sub>3</sub>OD.

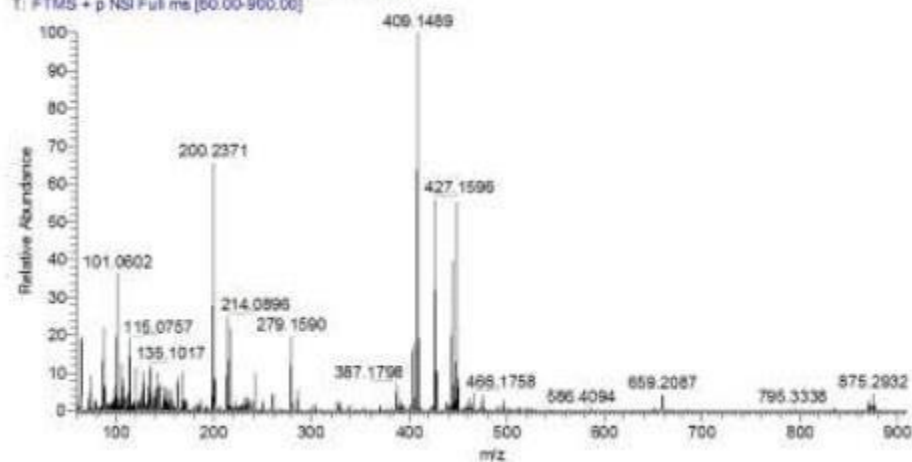


**Figure S86.** HMBC NMR spectrum of **10** in CD<sub>3</sub>OD.

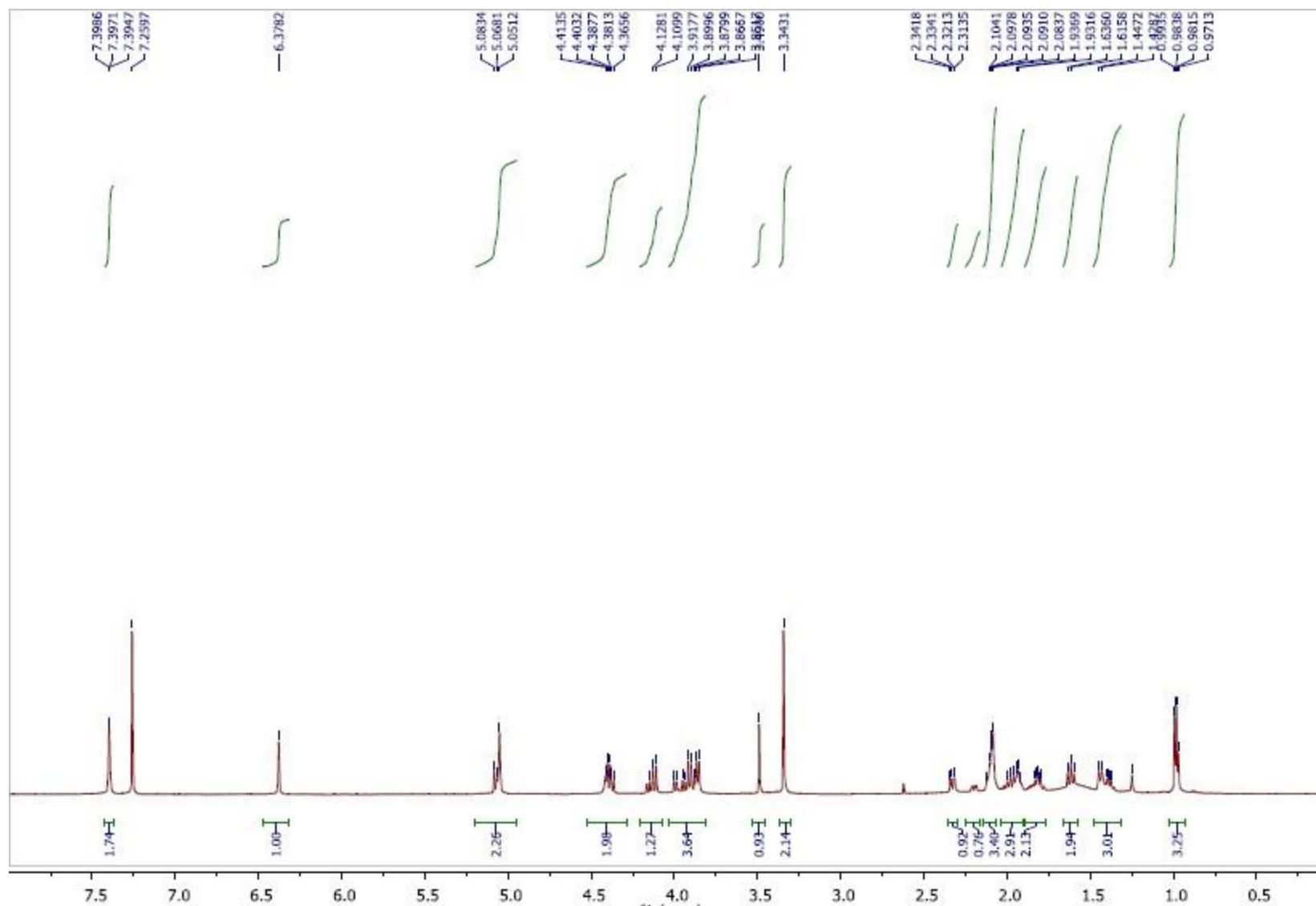
28\_01 (2) #159 RT: 1.05 AV: 1 NL: 1.54E7  
T: FTMS - p NSI Full ms [60.00-900.00]



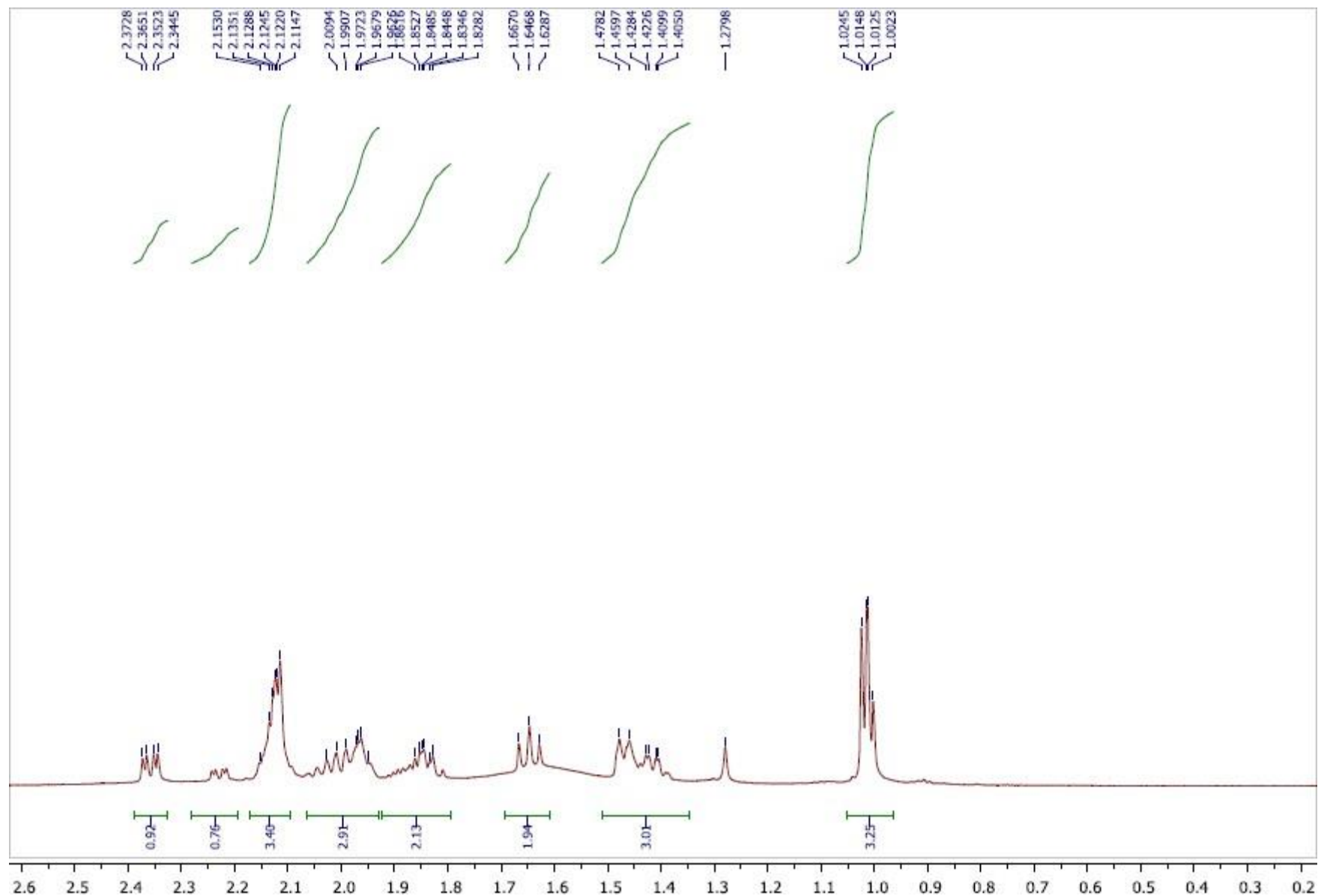
28\_01 (2) #3-263 RT: 0.06-0.97 AV: 31 NL: 1.66E7  
T: FTMS + p NSI Full ms [60.00-900.00]



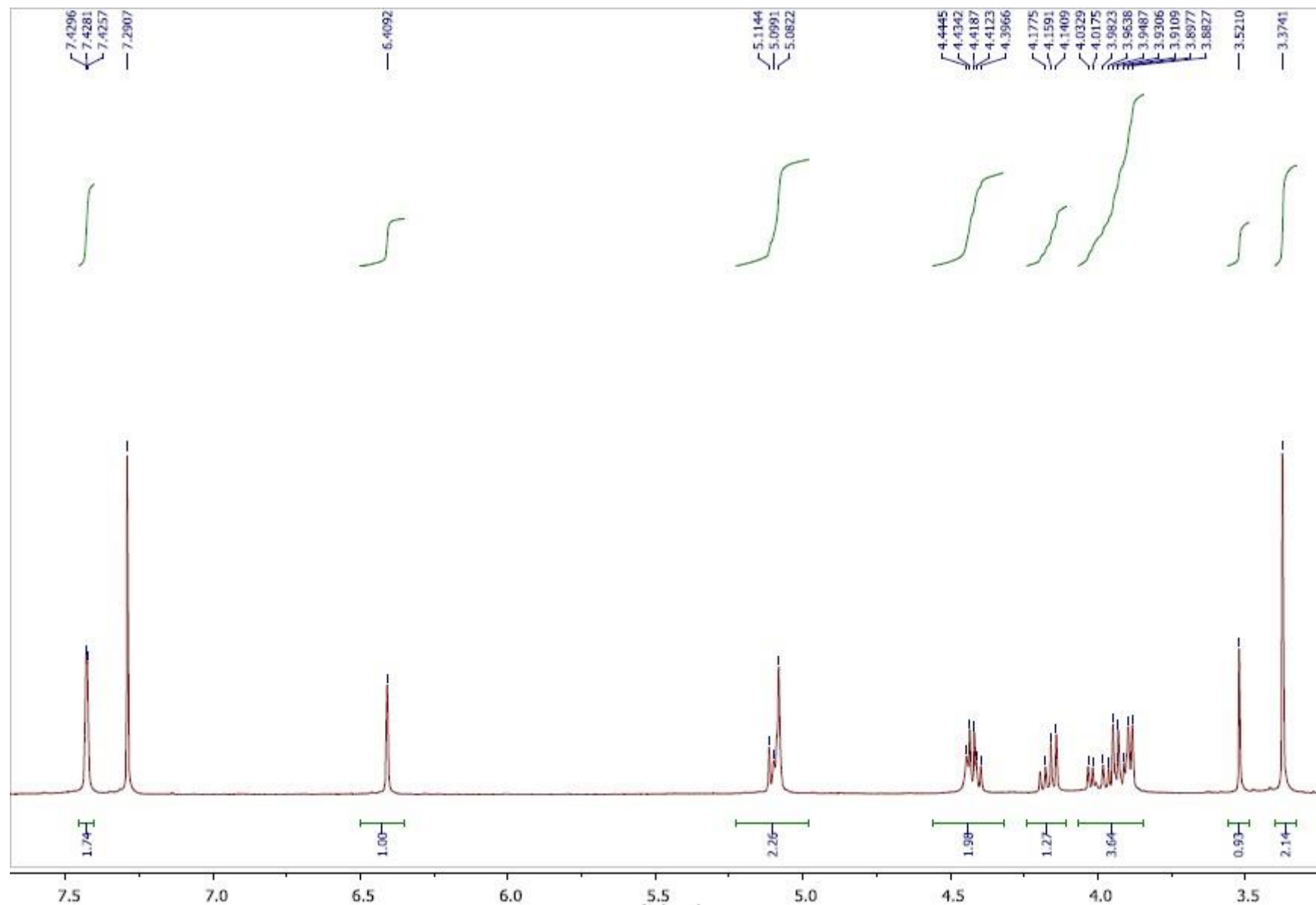
**Figure S87.** Positive-ion and negative-ion HRESIMS of **10**.



**Figure S88.**  $^1\text{H}$  NMR spectrum of **11** in  $\text{CD}_3\text{OD}$ .

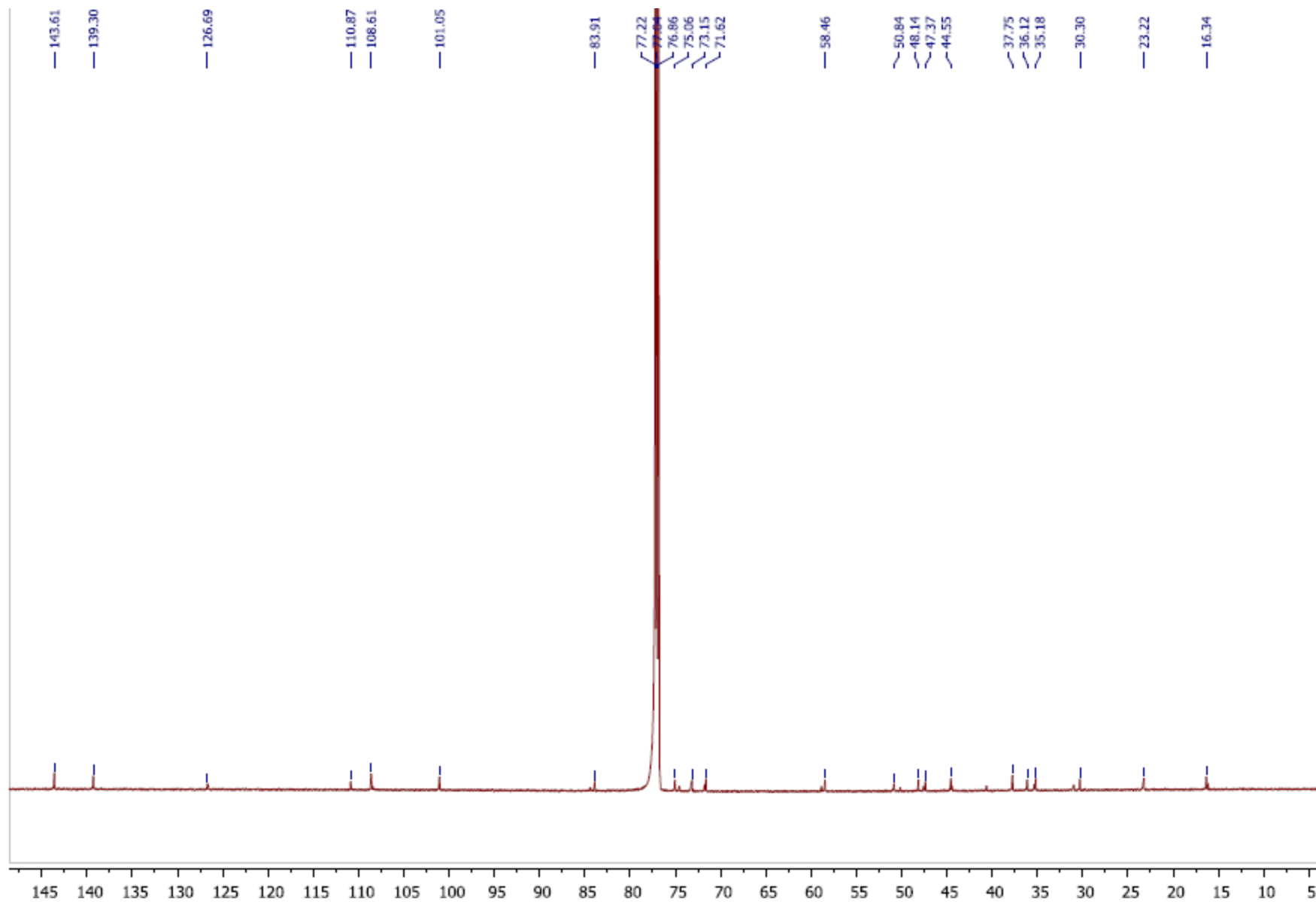


**Figure S89.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.2 –  $\delta$  2.6) of **11** in  $\text{CD}_3\text{OD}$ .

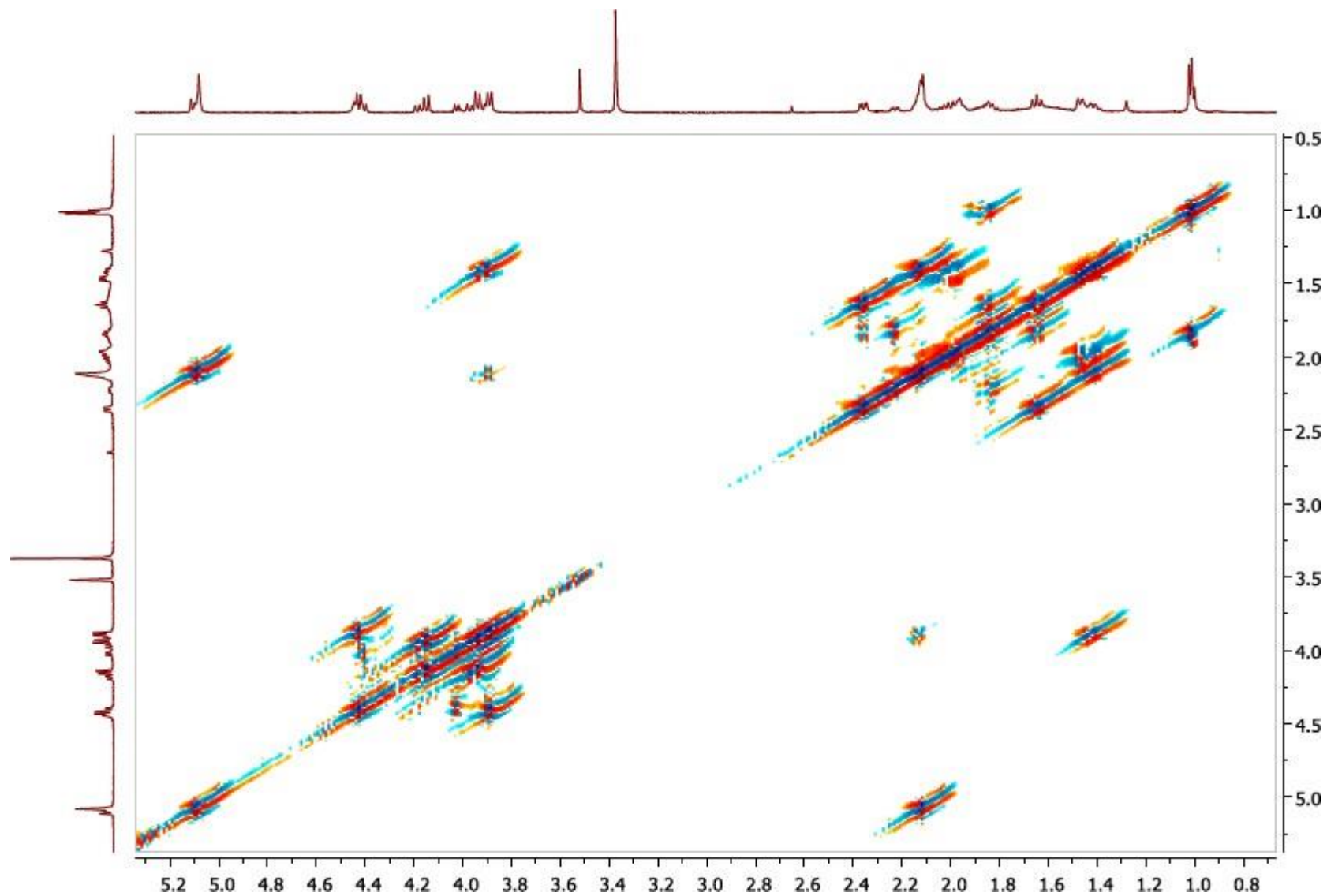


**Figure S90.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  3.4 –  $\delta$  7.5) of **11** in  $\text{CD}_3\text{OD}$ .

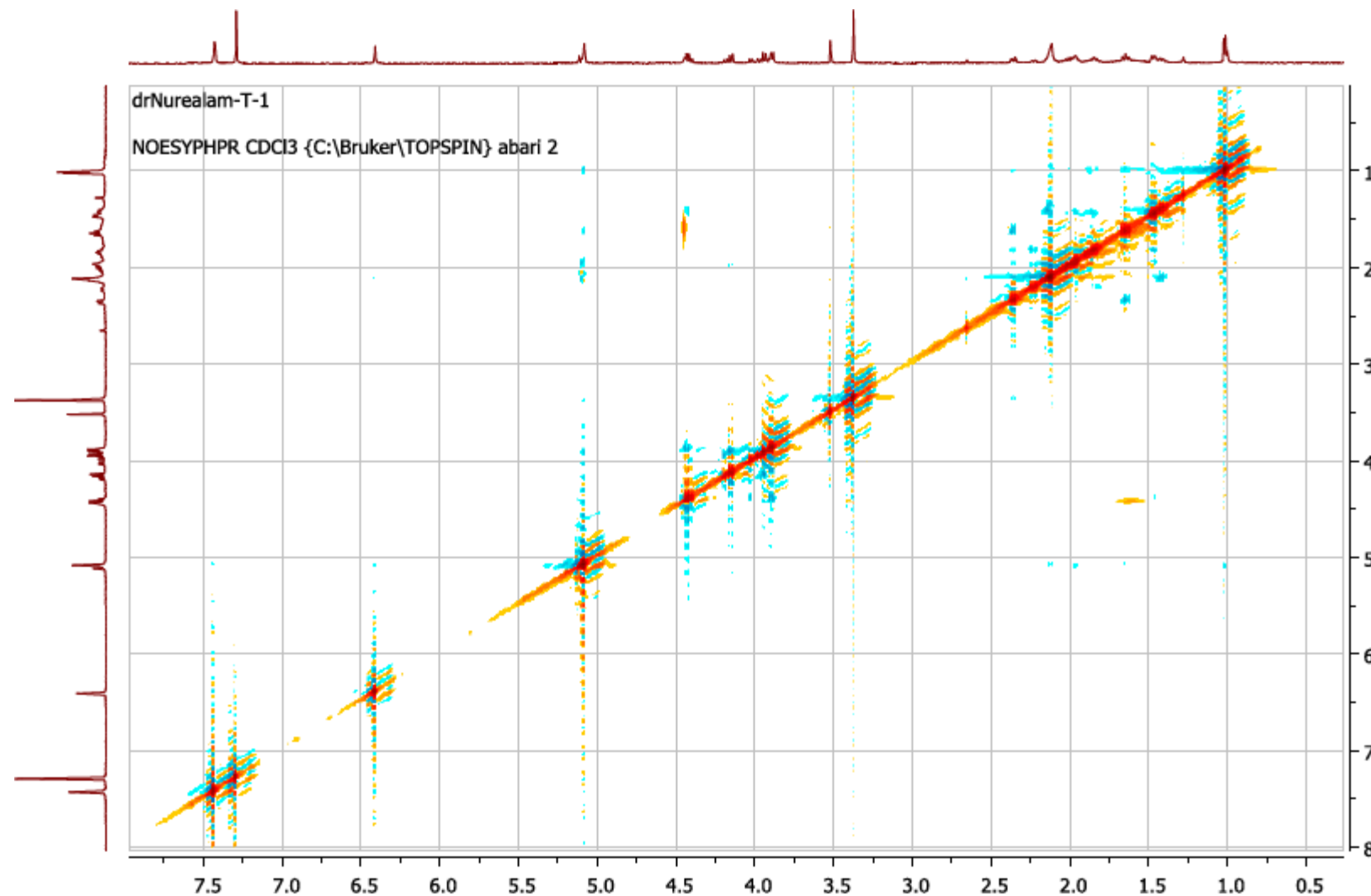




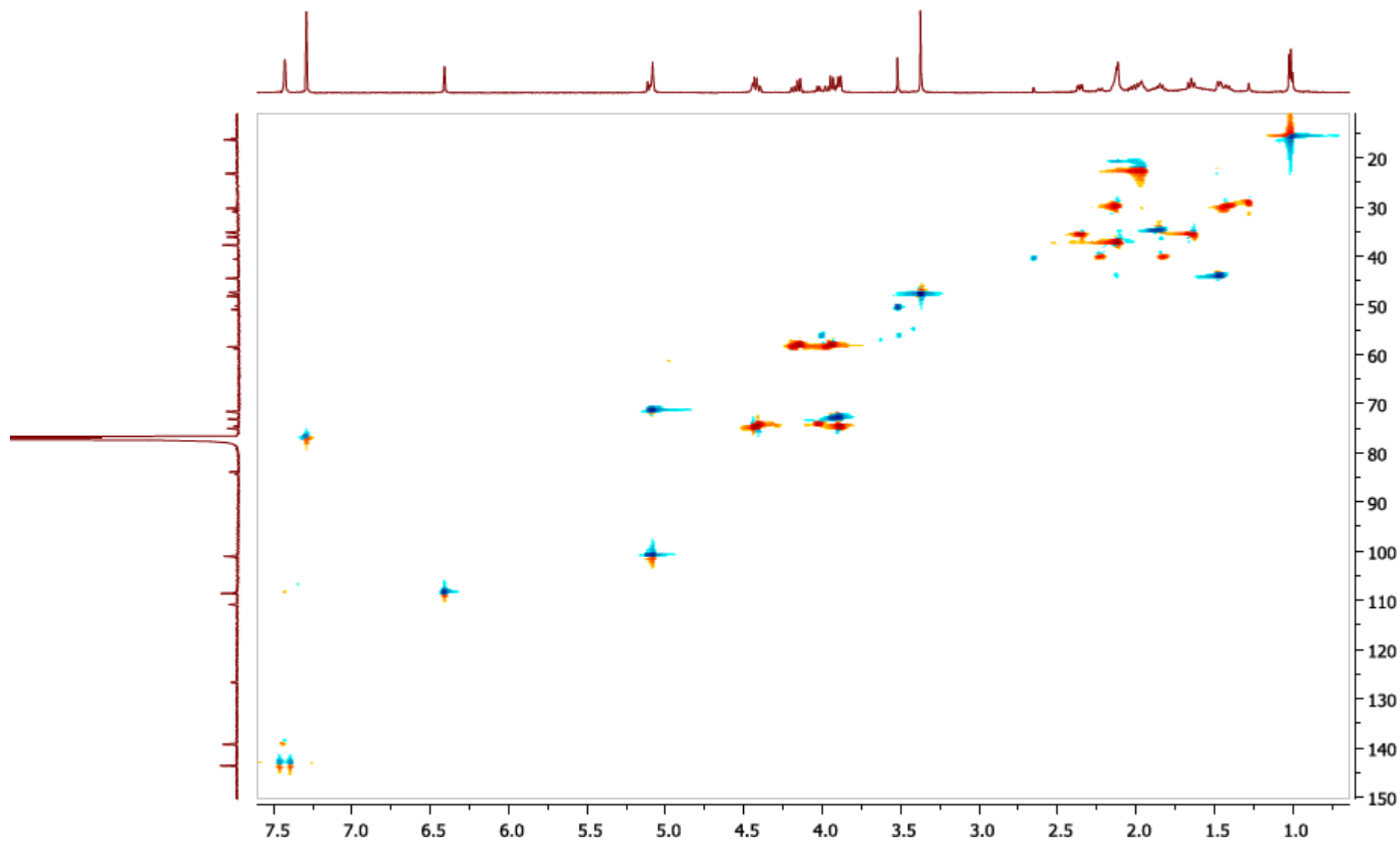
**Figure S91.**  $^{13}\text{C}$  NMR spectrum of **11** in  $\text{CD}_3\text{OD}$ .



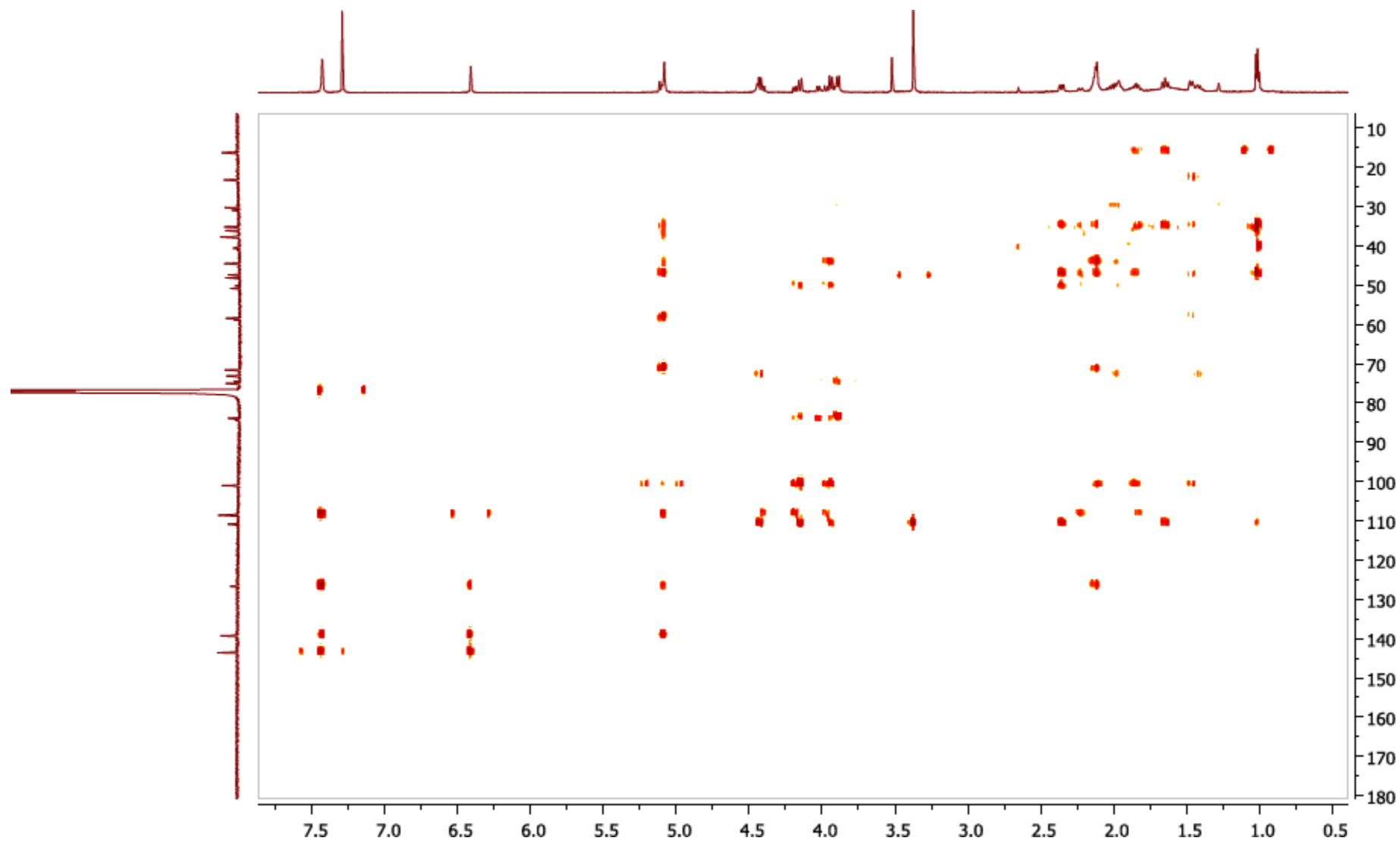
**Figure S92.** COSY NMR spectrum of **11** in CD<sub>3</sub>OD.



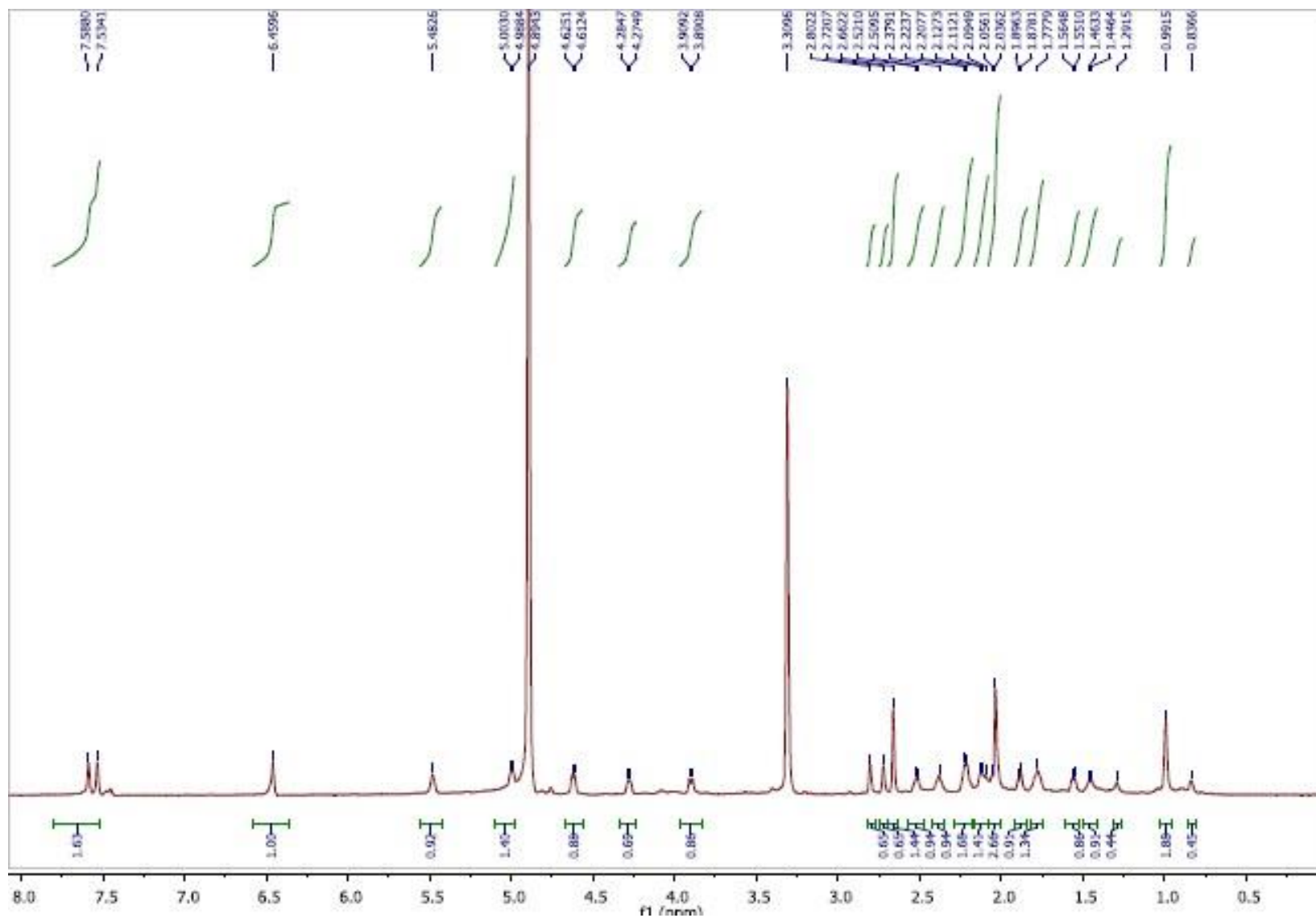
**Figure S93.** NOESY NMR spectrum of **11** in CD<sub>3</sub>OD.



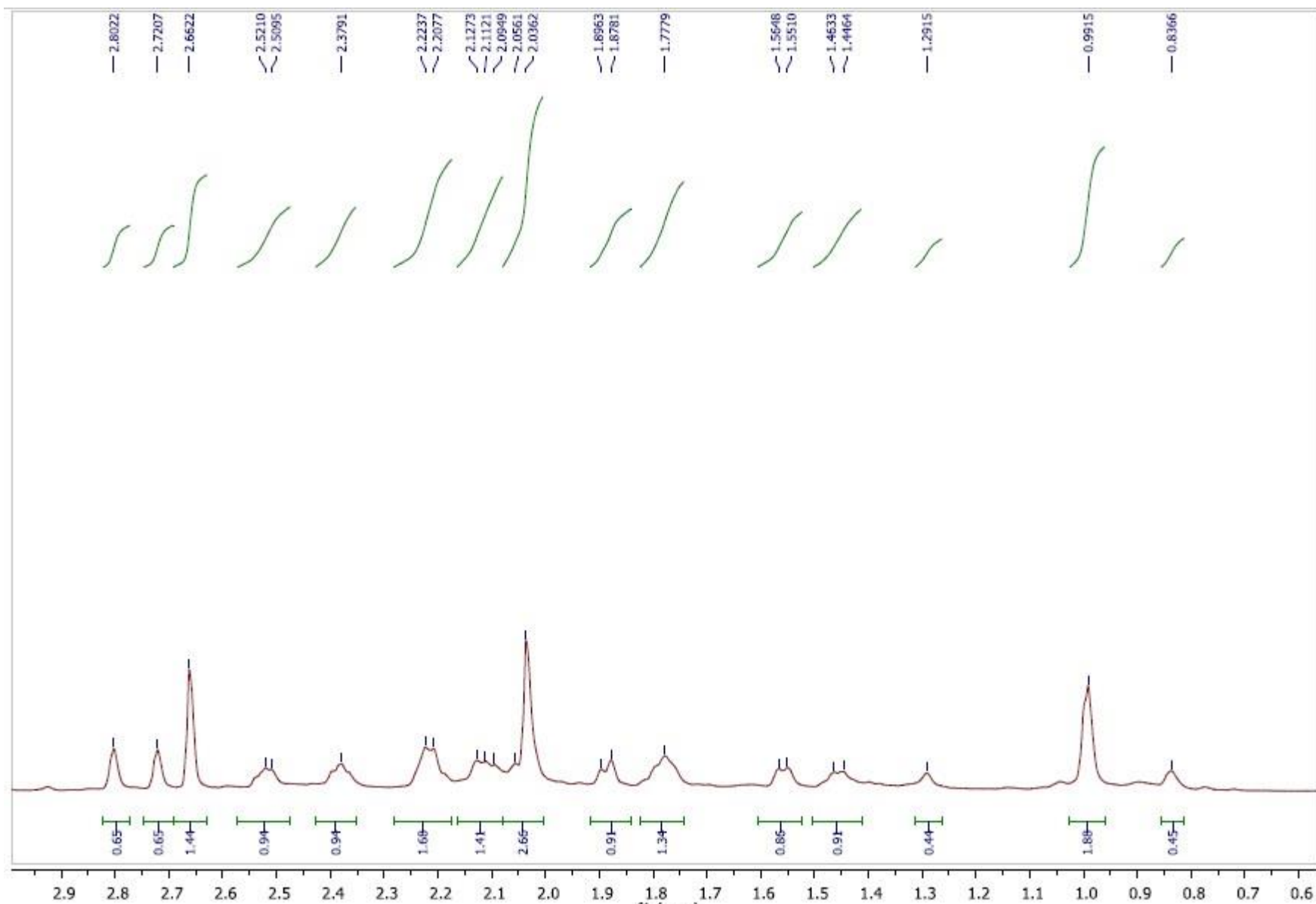
**Figure S94.** HSQC NMR spectrum of **11** in CD<sub>3</sub>OD.



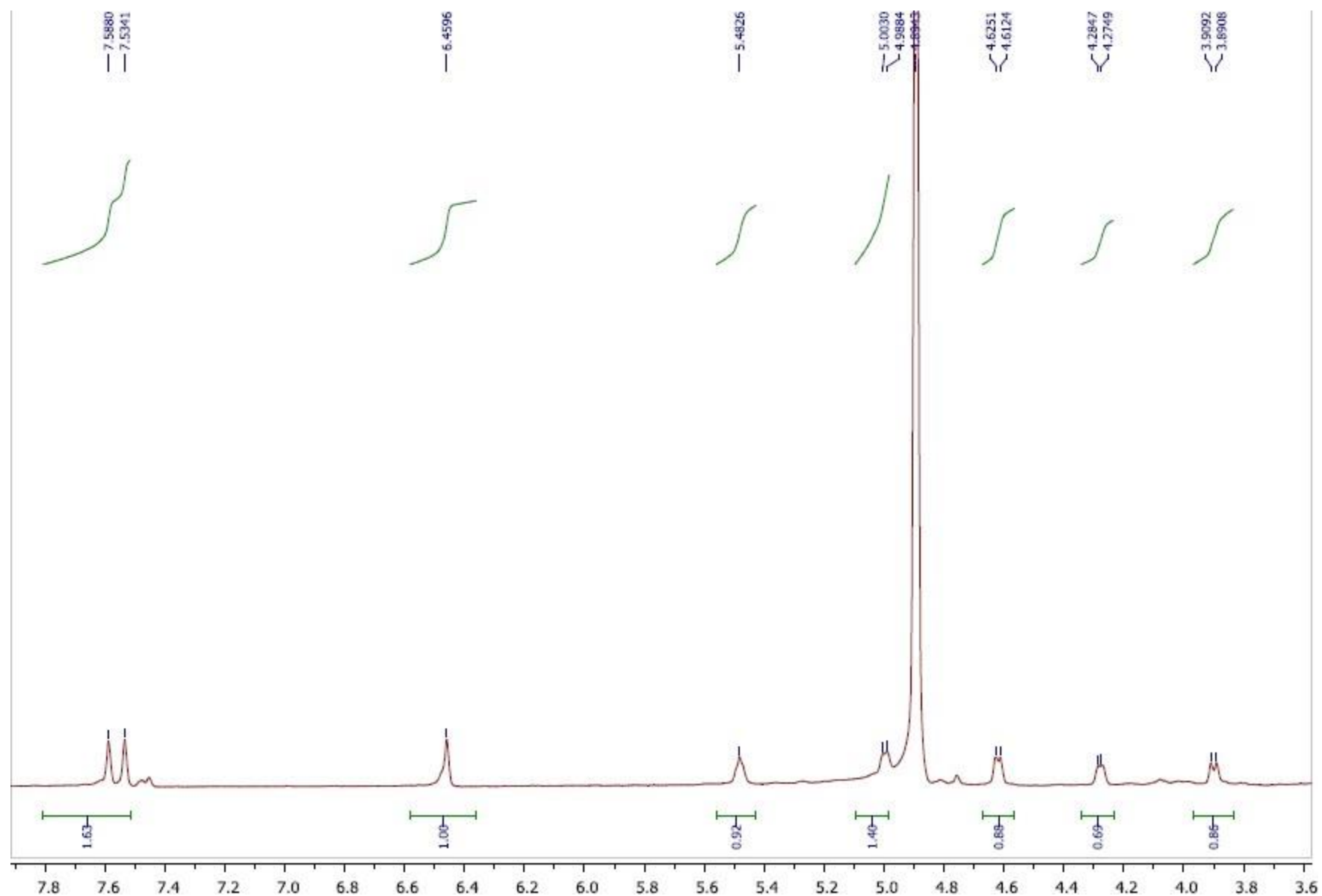
**Figure S95.** HMBC NMR spectrum of **11** in CD<sub>3</sub>OD.



**Figure S96.** <sup>1</sup>H NMR spectrum of **12** in CD<sub>3</sub>OD.

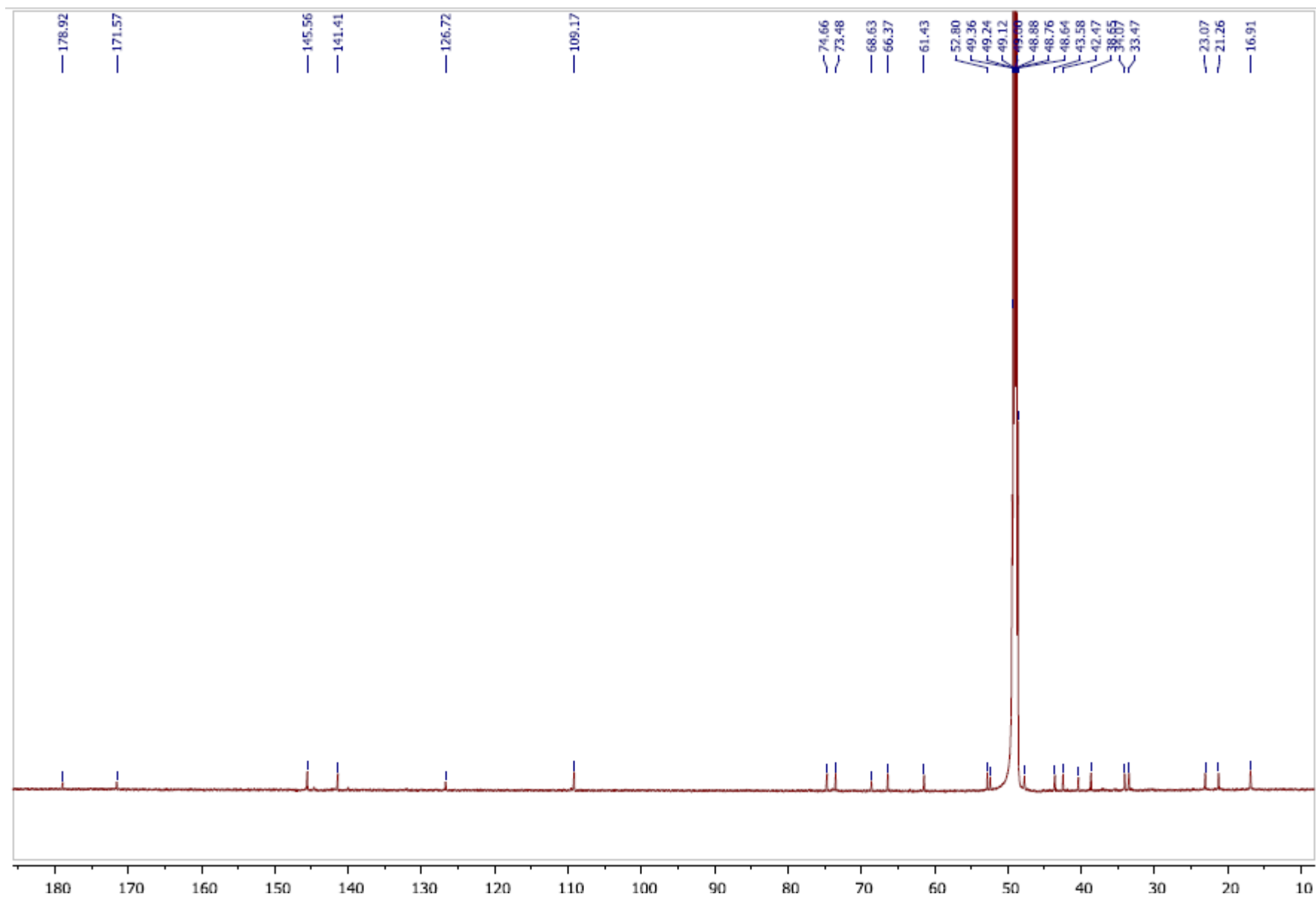


**Figure S97.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.6 –  $\delta$  2.9) of **12** in  $\text{CD}_3\text{OD}$ .

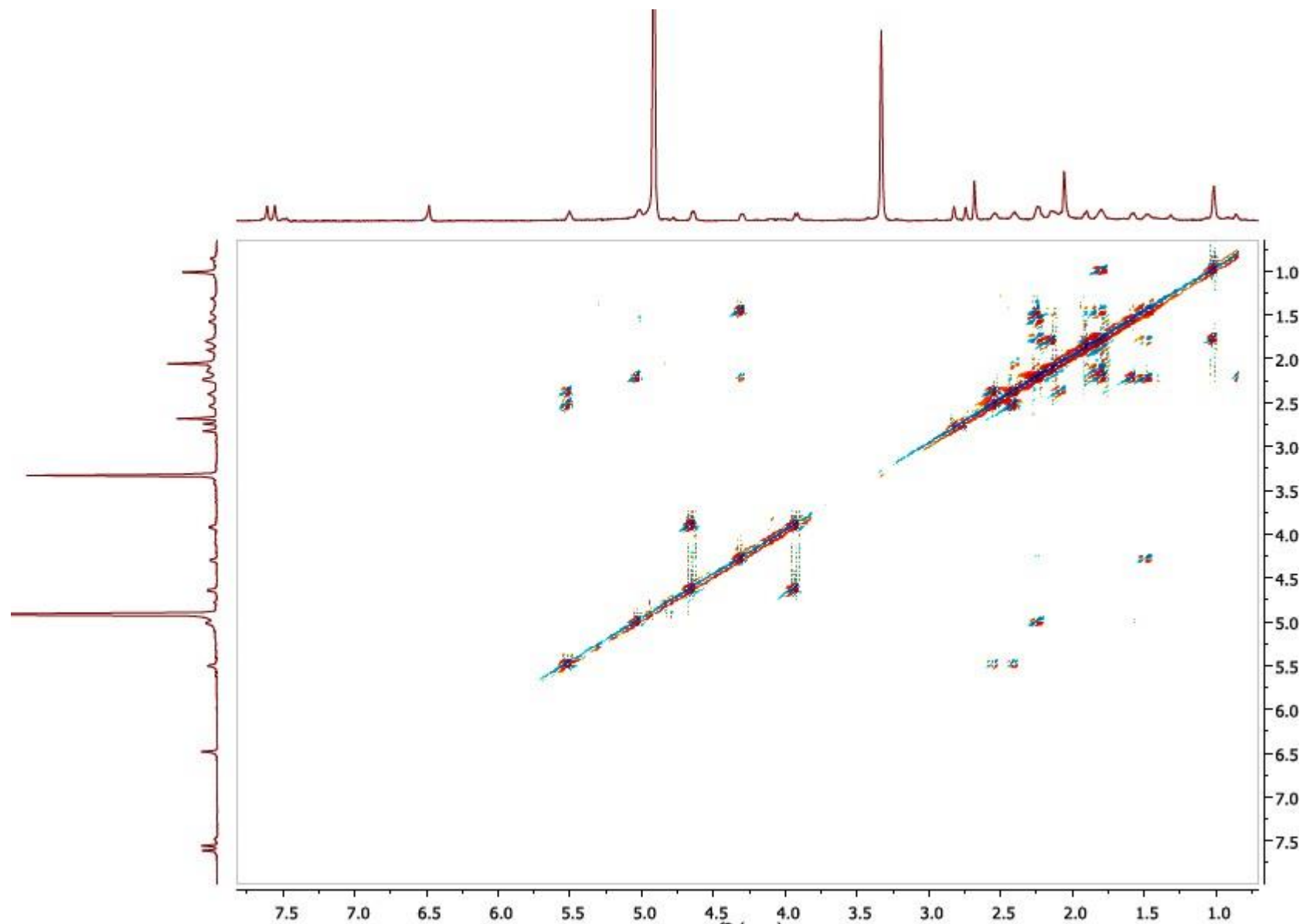


**Figure S98.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  3.6 –  $\delta$  7.8) of **12** in  $\text{CD}_3\text{OD}$ .

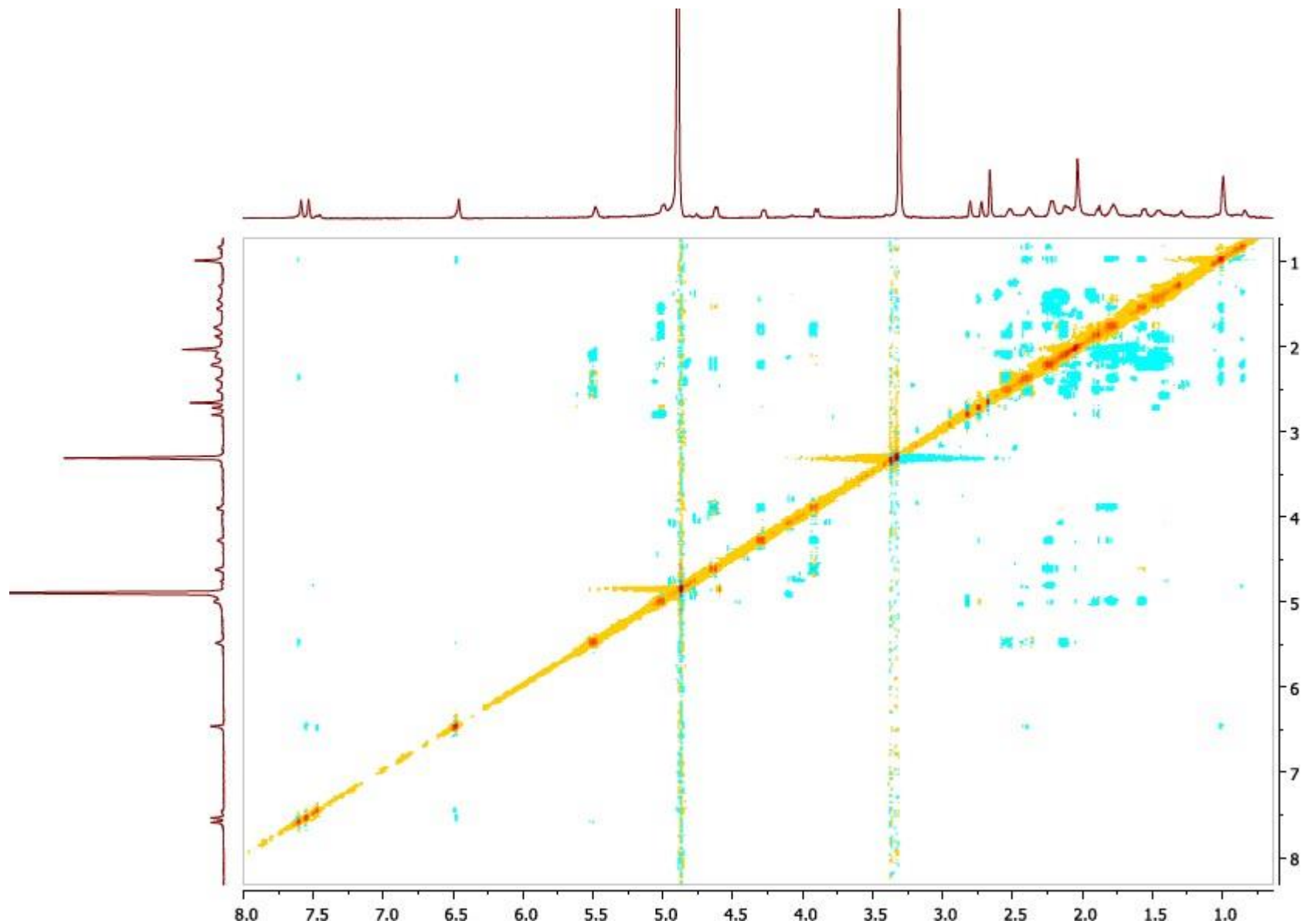




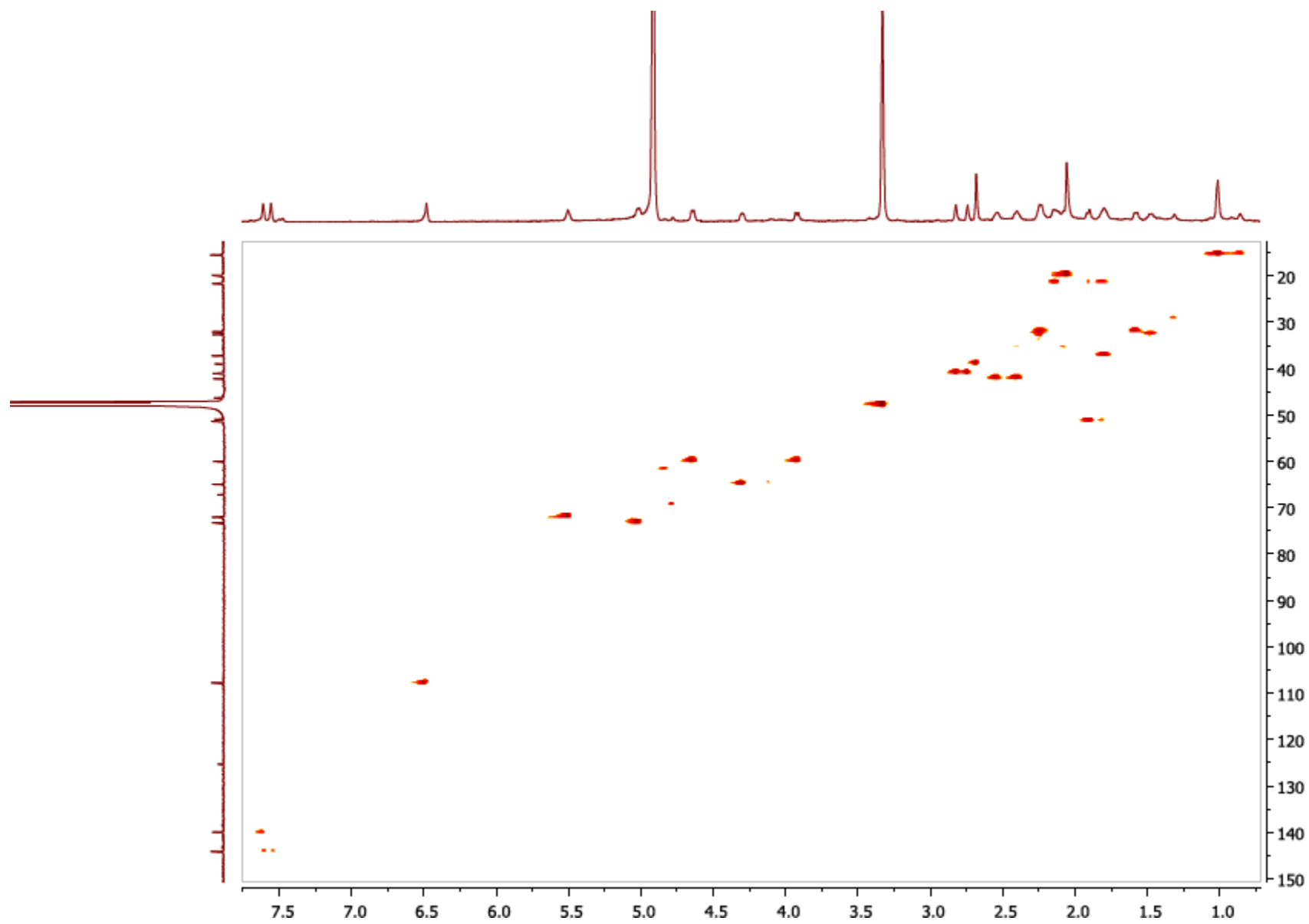
**Figure S99.**  $^{13}\text{C}$  NMR spectrum of **12** in  $\text{CD}_3\text{OD}$ .



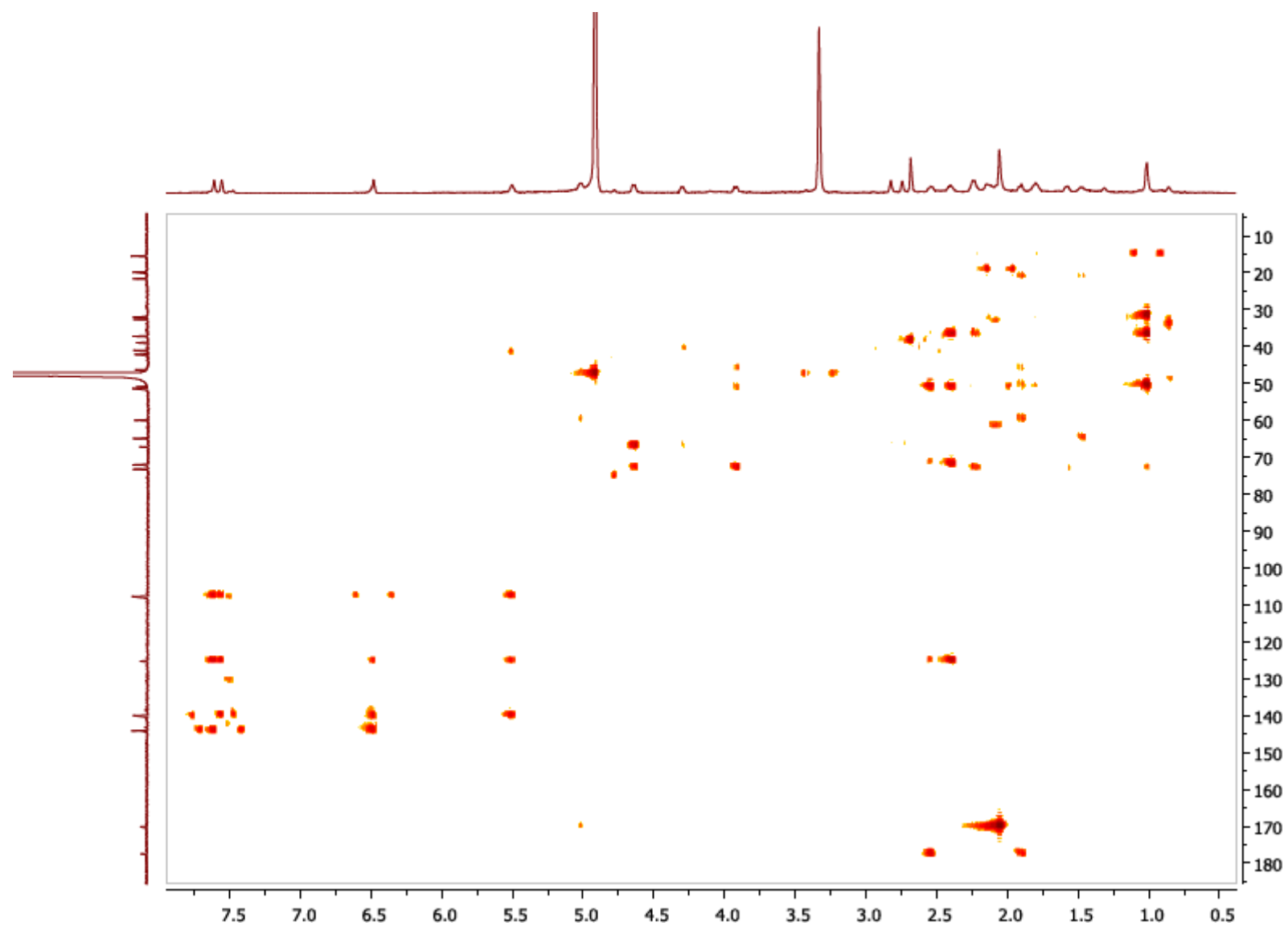
**Figure S100.** COSY NMR spectrum of **12** in CD<sub>3</sub>OD.



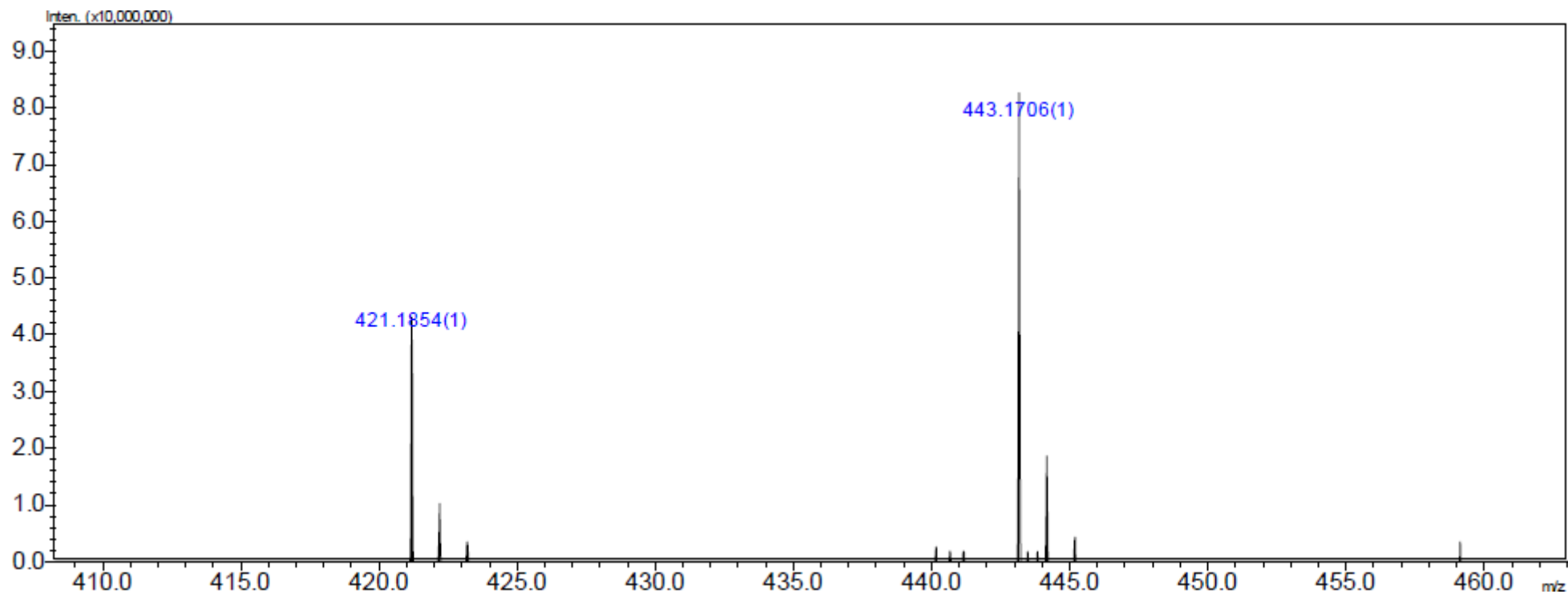
**Figure S101.** NOESY NMR spectrum of **12** in  $\text{CD}_3\text{OD}$ .



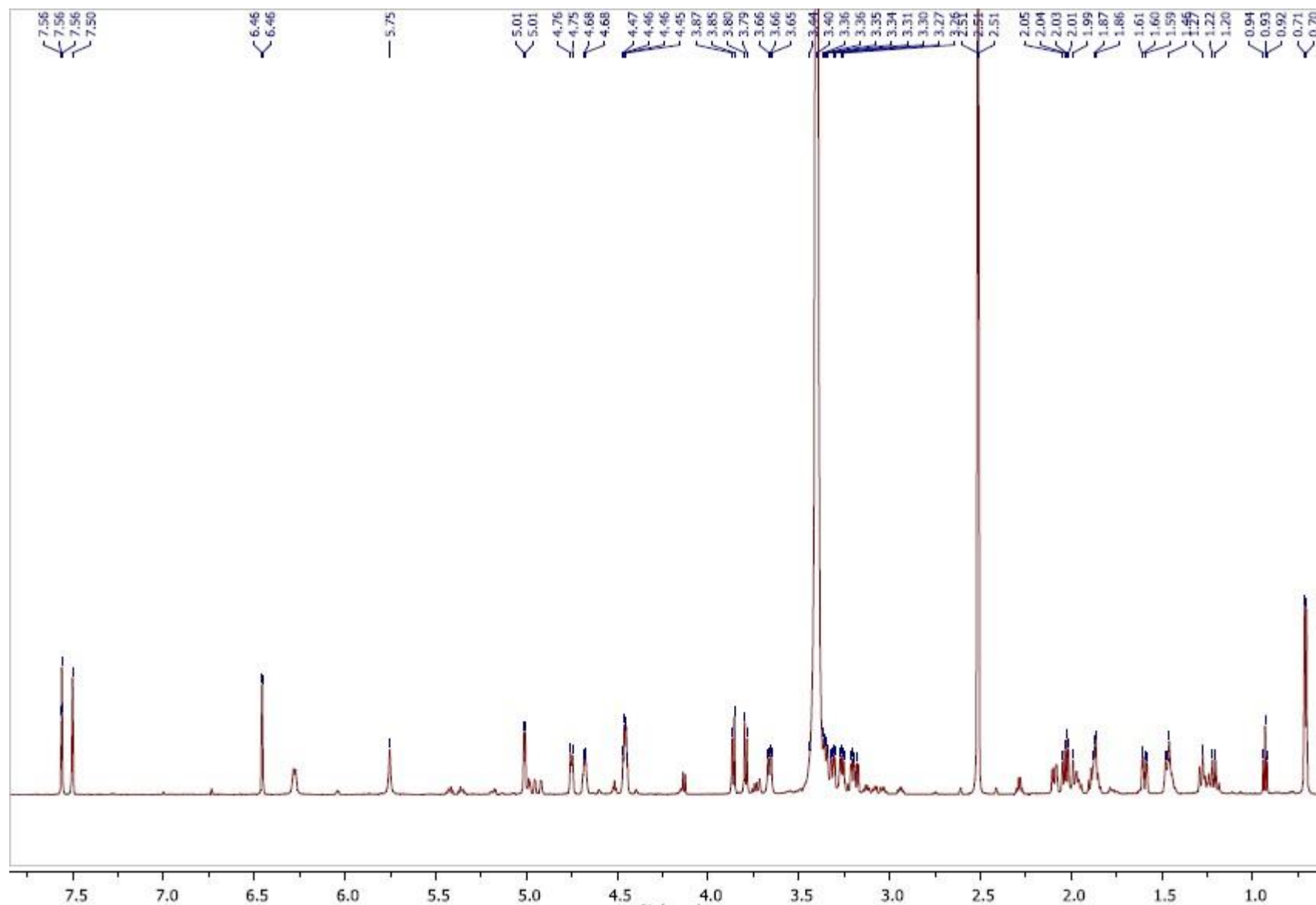
**Figure S102.** HSQC NMR spectrum of **12** in CD<sub>3</sub>OD.



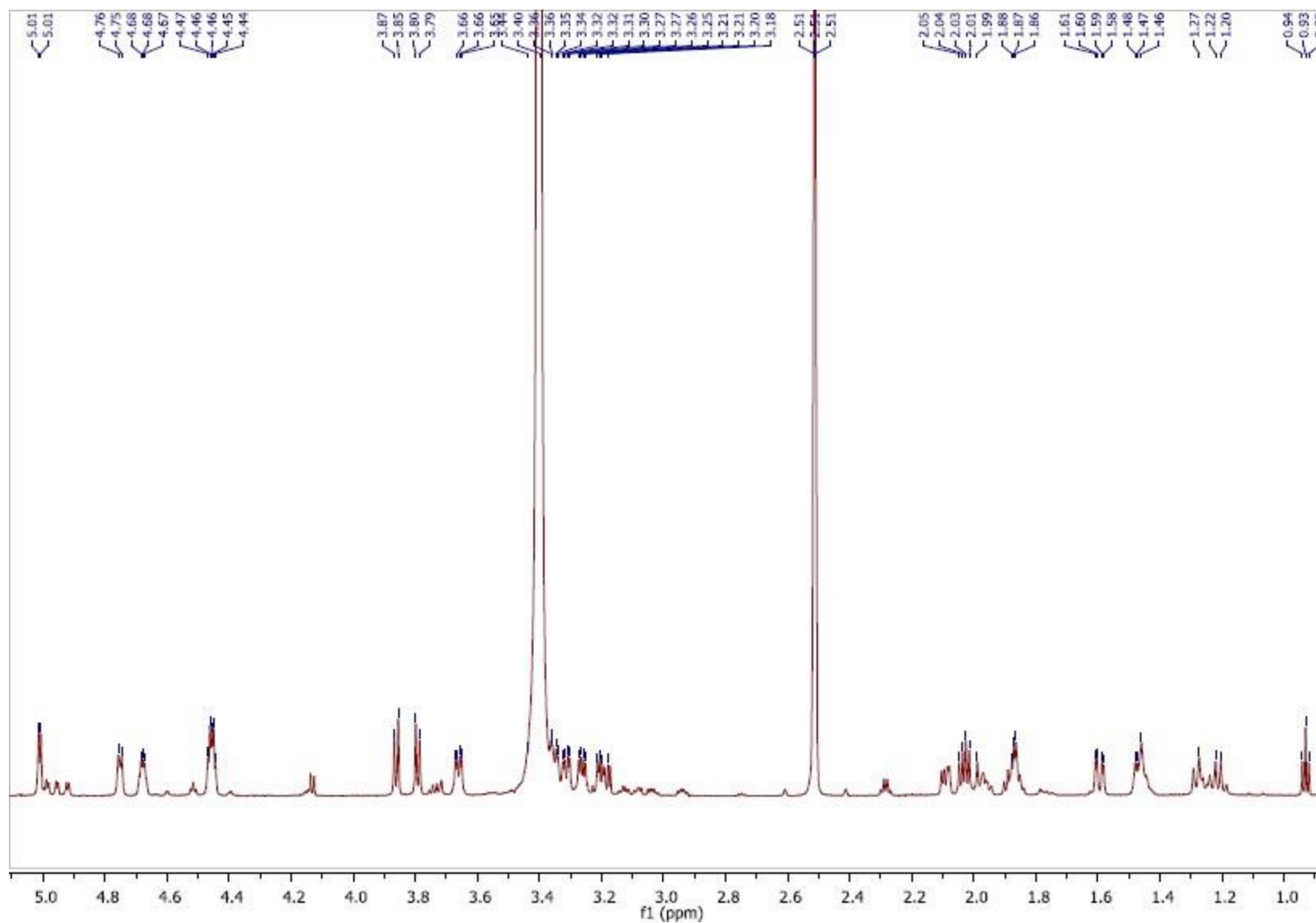
**Figure S103.** HMBC NMR spectrum of **12** in CD<sub>3</sub>OD.



**Figure S104.** Positive-ion HRESIMS of **12**.

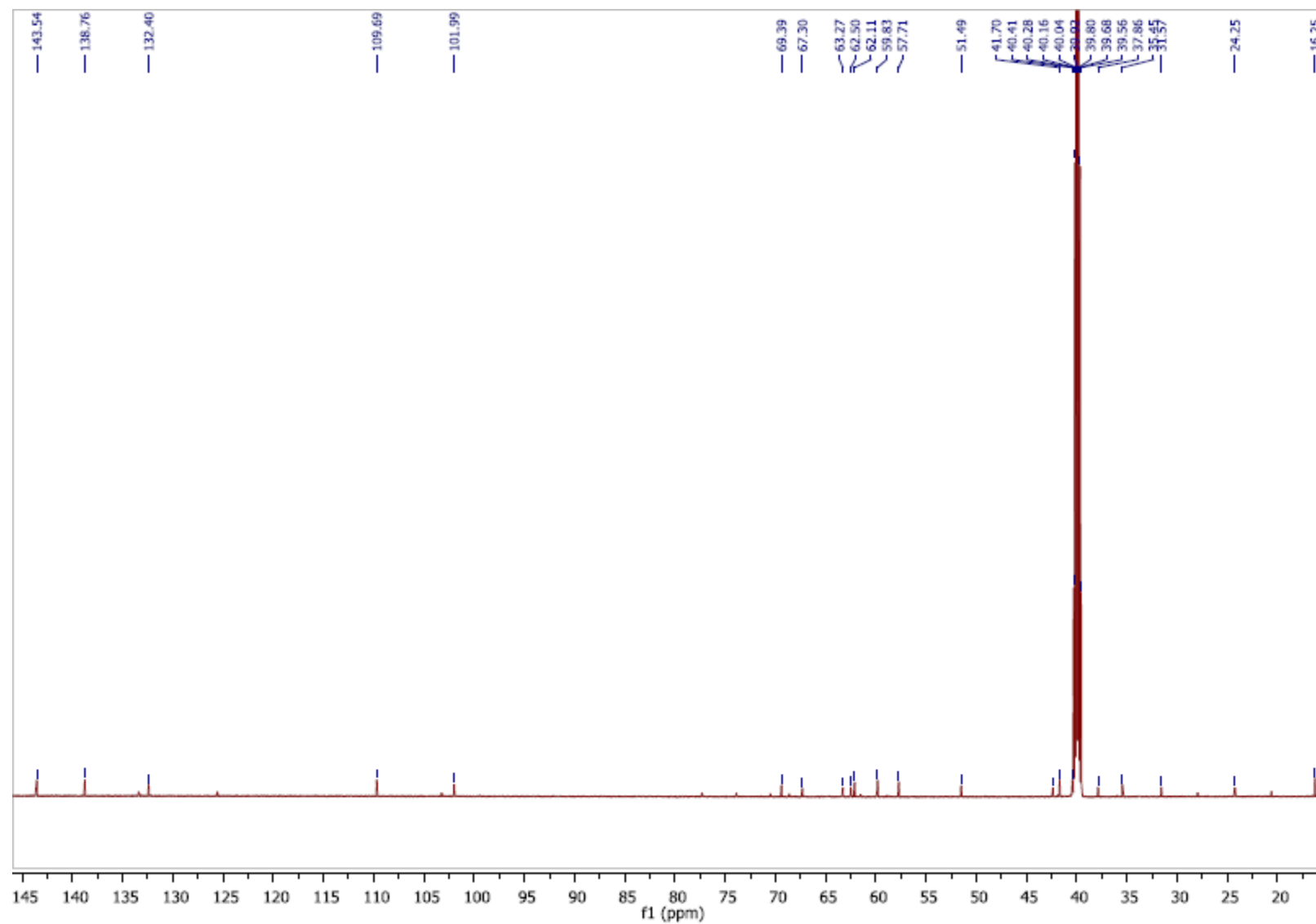


**Figure S105.**  $^1\text{H}$  NMR spectrum of **13** in  $(\text{CD}_3)_2\text{SO}$ .

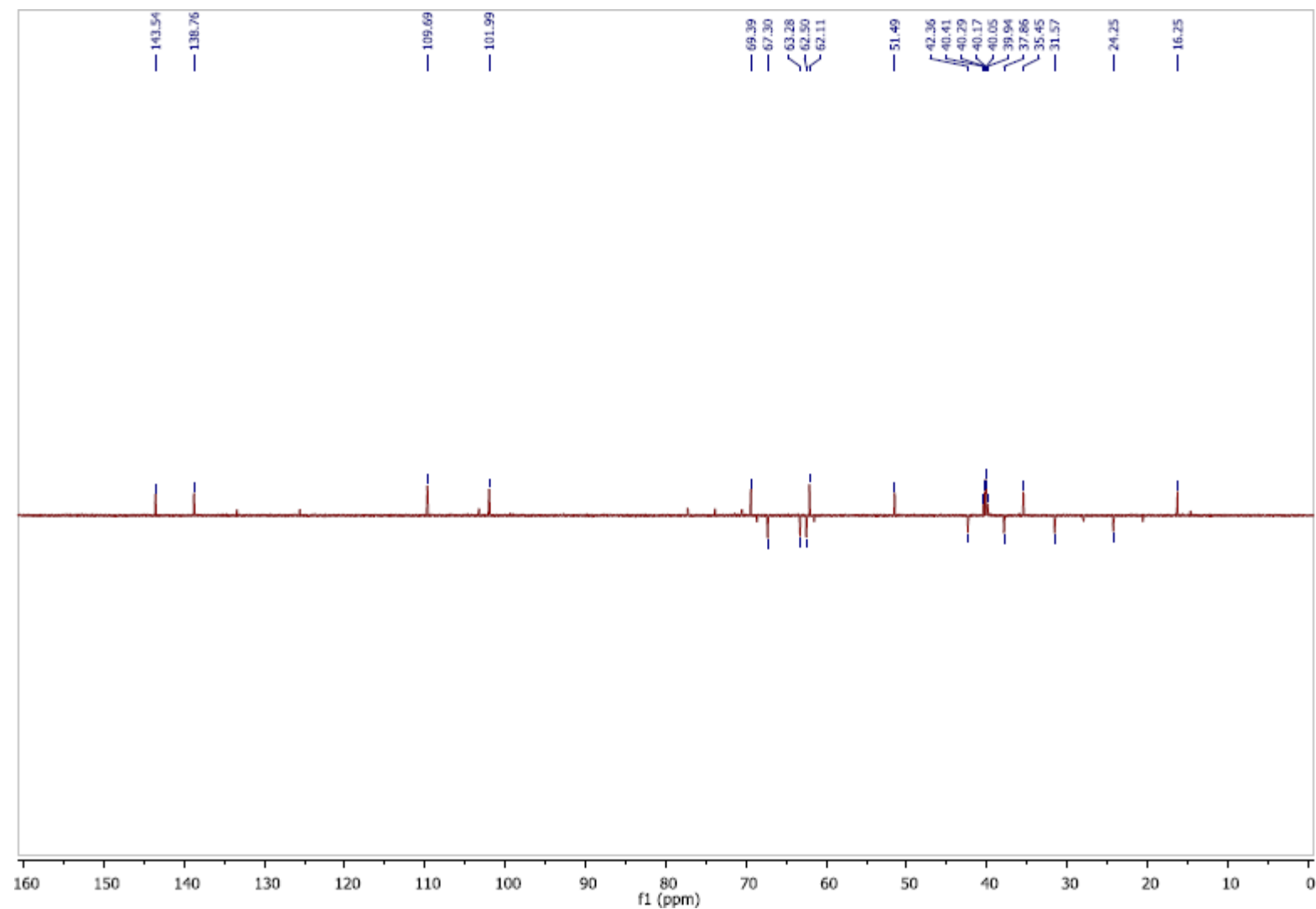


**Figure S106.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.9 –  $\delta$  5.1) of **13** in  $(\text{CD}_3)_2\text{SO}$ .

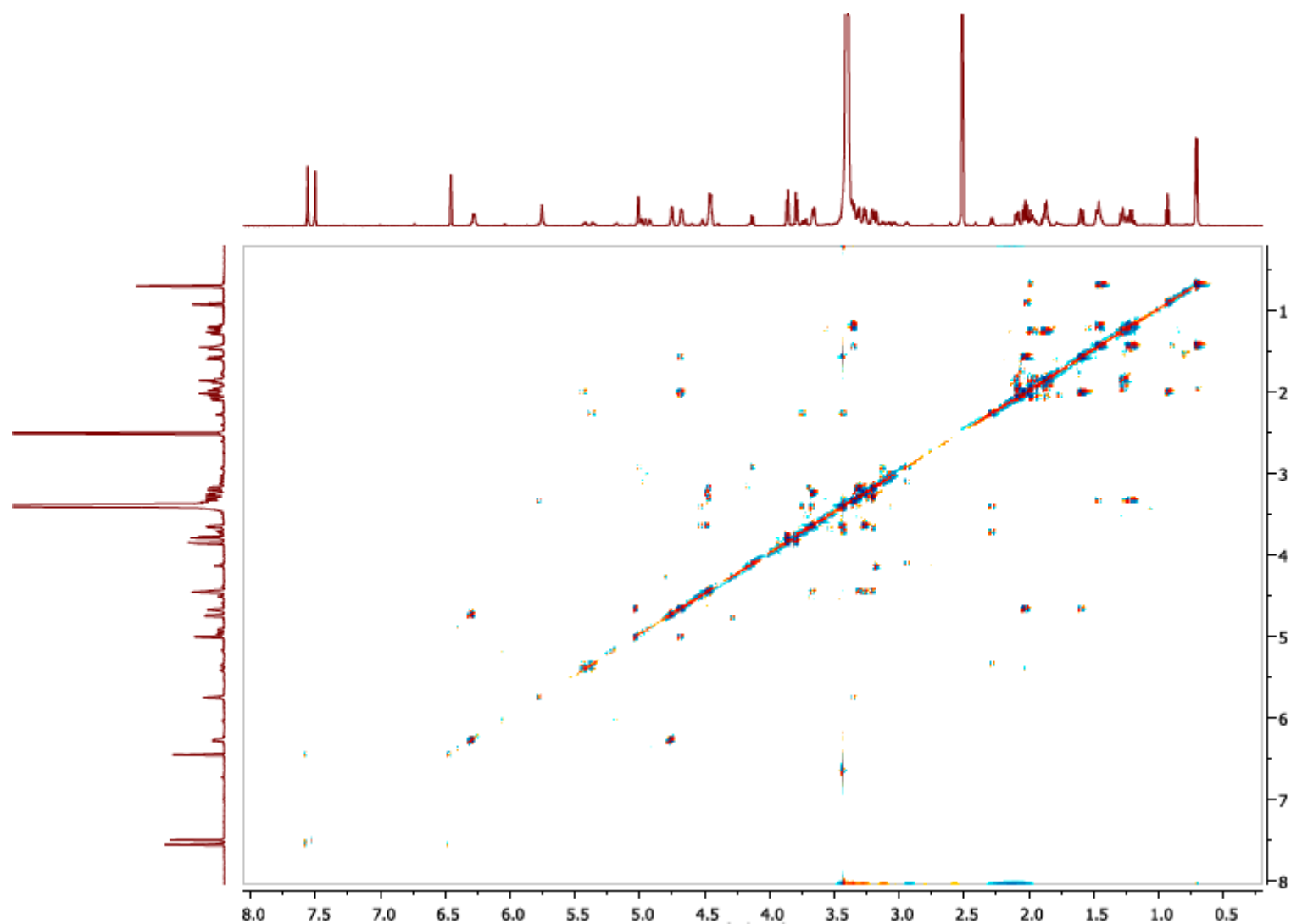




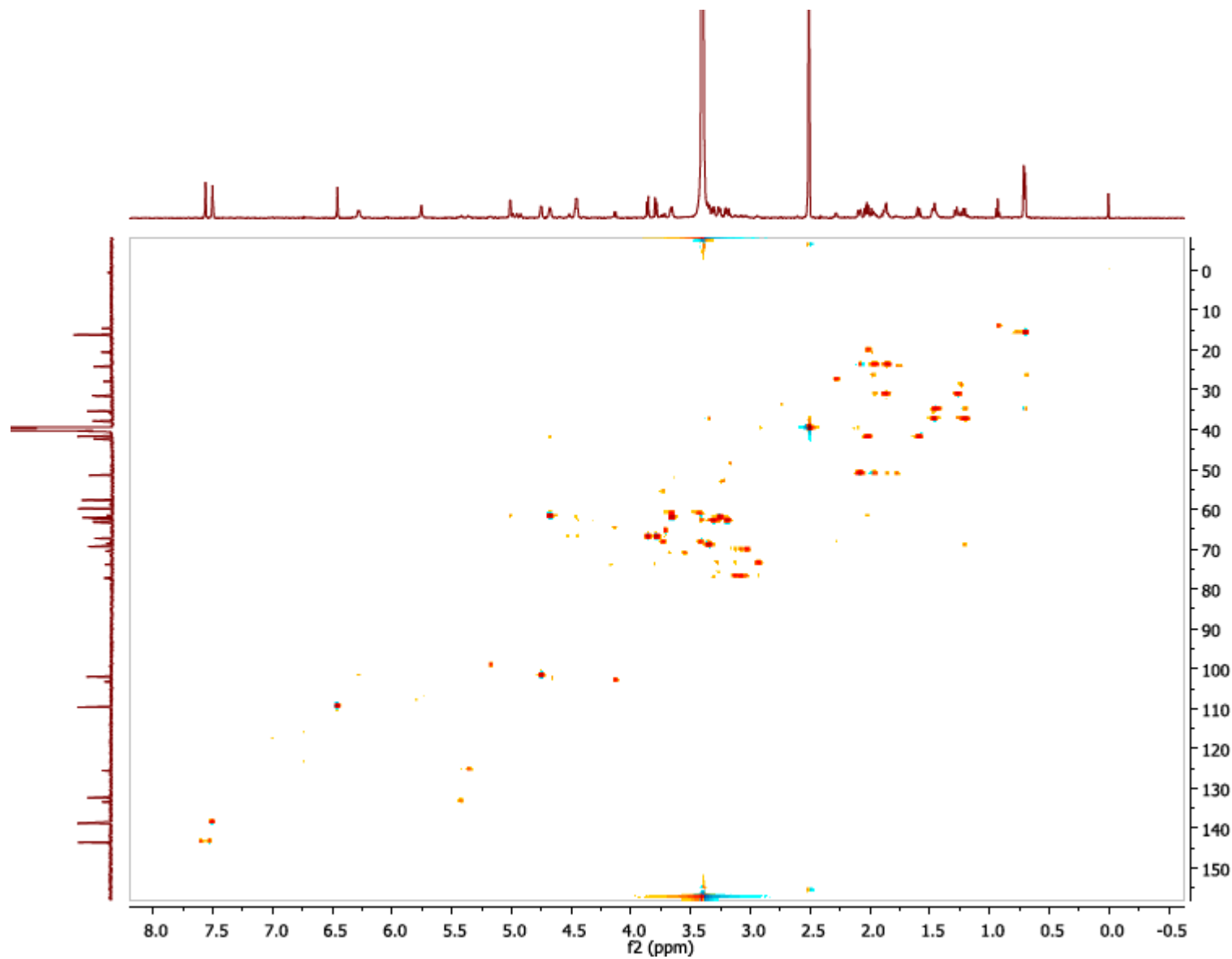
**Figure S107.** <sup>13</sup>C NMR spectrum of **13** in (CD<sub>3</sub>)<sub>2</sub>SO.



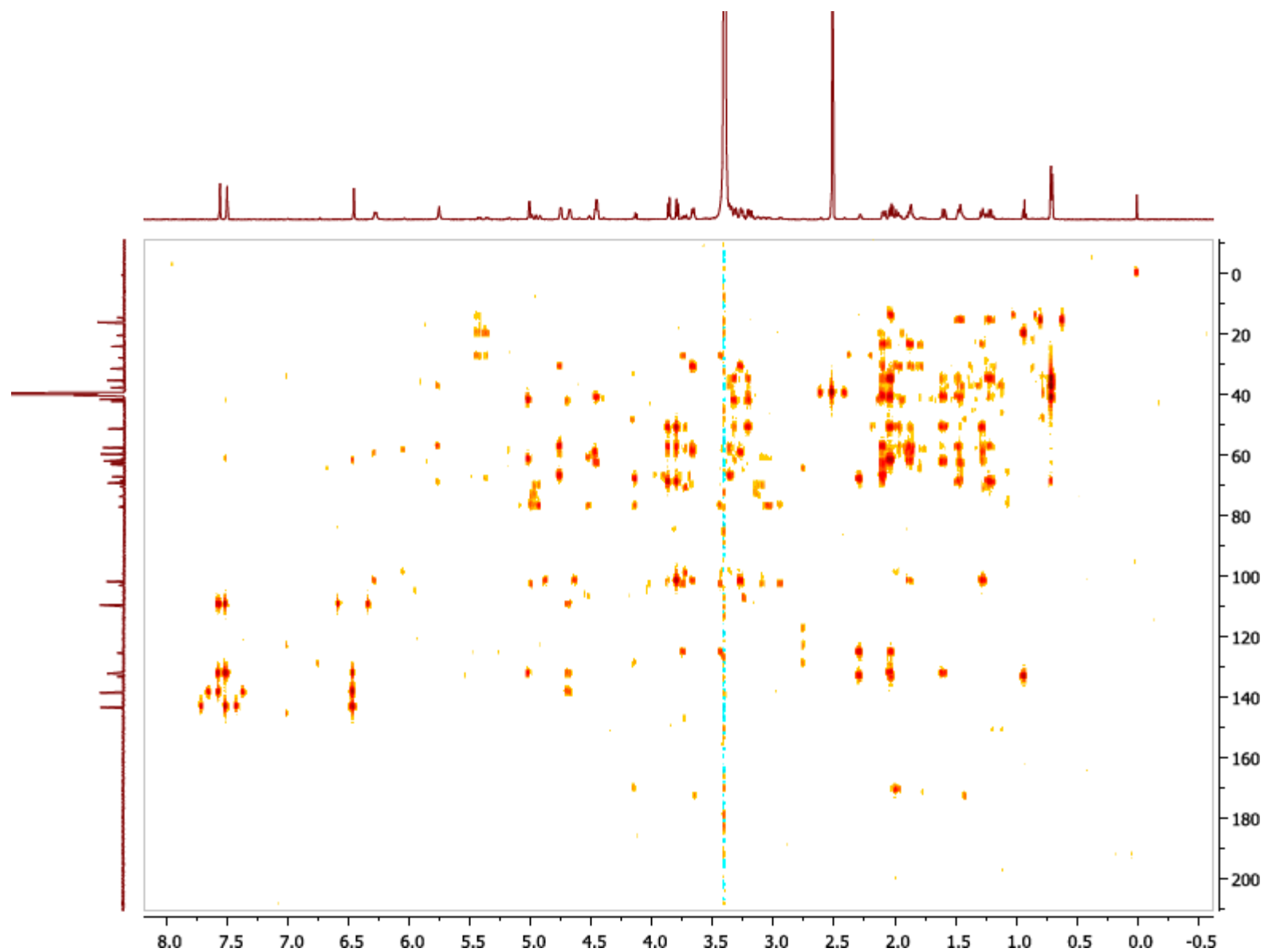
**Figure S108.** 135DEPT NMR spectrum of **13** in  $(\text{CD}_3)_2\text{SO}$ .



**Figure S109.** COSY NMR spectrum of **13** in  $(\text{CD}_3)_2\text{SO}$ .

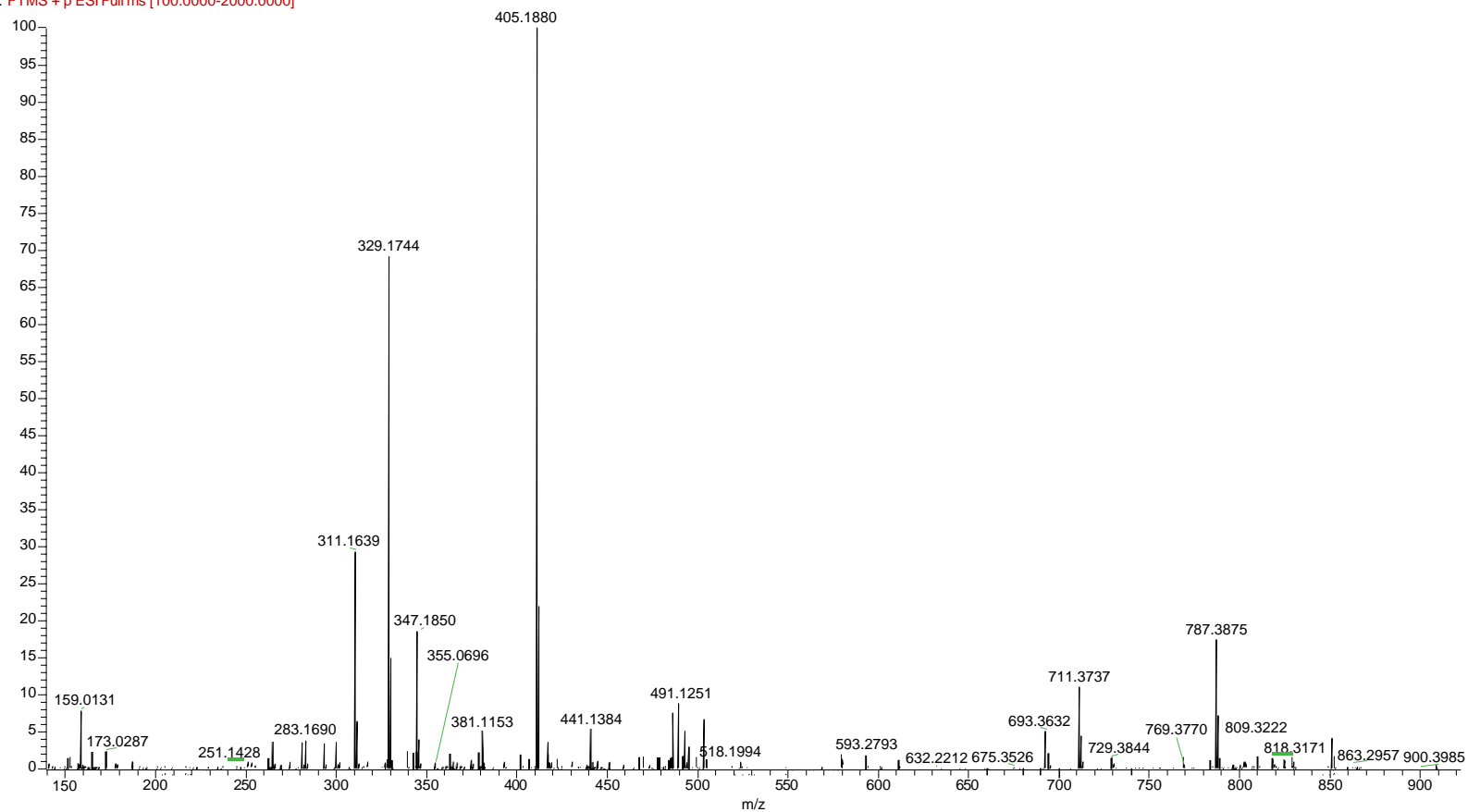


**Figure S110.** HSQC NMR spectrum of **13** in  $(\text{CD}_3)_2\text{SO}$ .



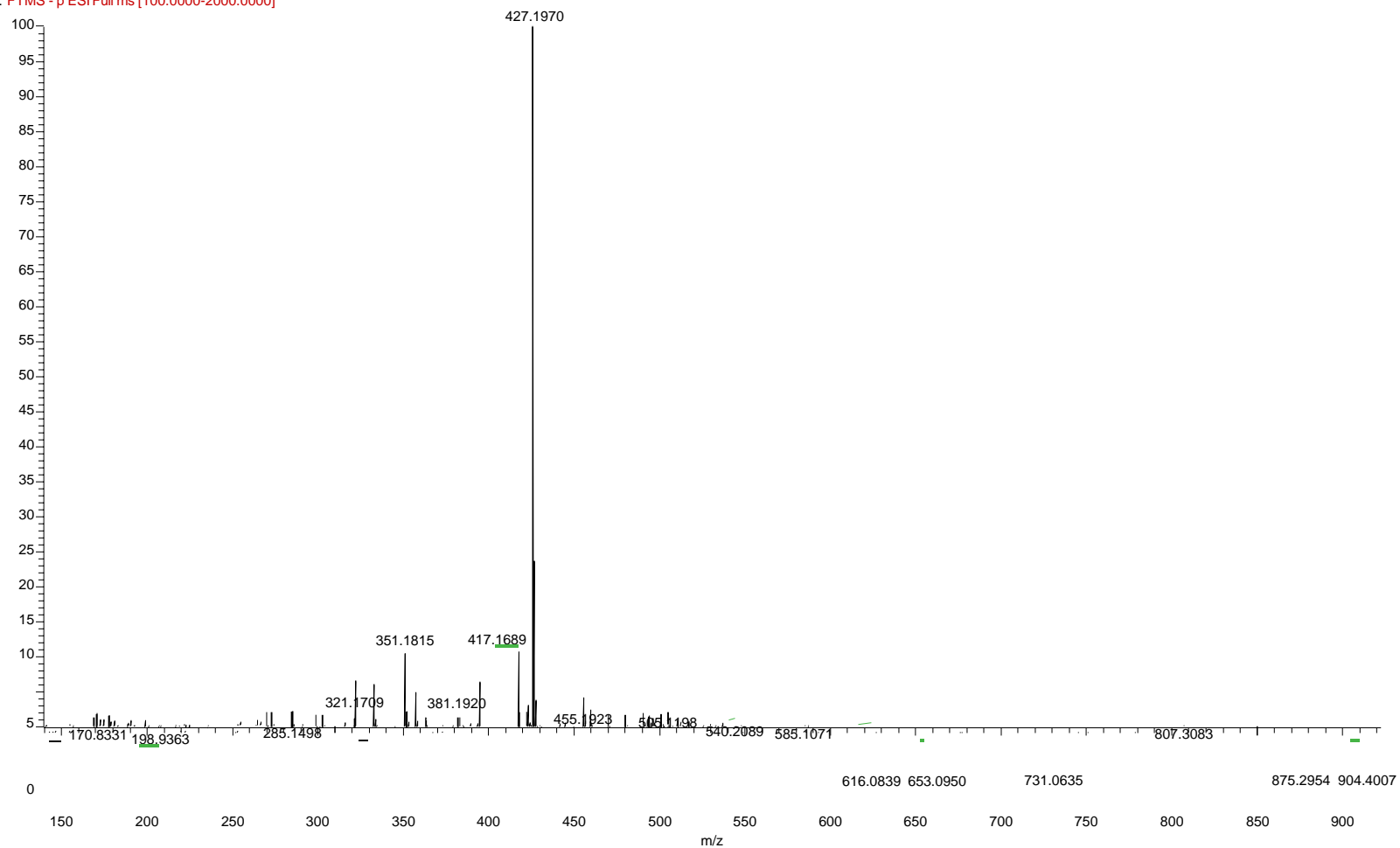
**Figure S111.** HMBC NMR spectrum of **13** in  $(\text{CD}_3)_2\text{SO}$ .

R13 #232-252 RT: 3.34-3.58 AV: 10 NL: 1.43E7  
F: FTMS + p ESI Full ms [100.0000-2000.0000]



**Figure S112.** Positive-ion HRESIMS of **13**.

R13 #232-252 RT: 3.32-3.60 AV: 11 NL: 7.33E6  
F: FTMS - p ESI Full ms [100.0000-2000.0000]





**Figure S113.** Negative-ion HRESIMS of **13**.

TB11B1

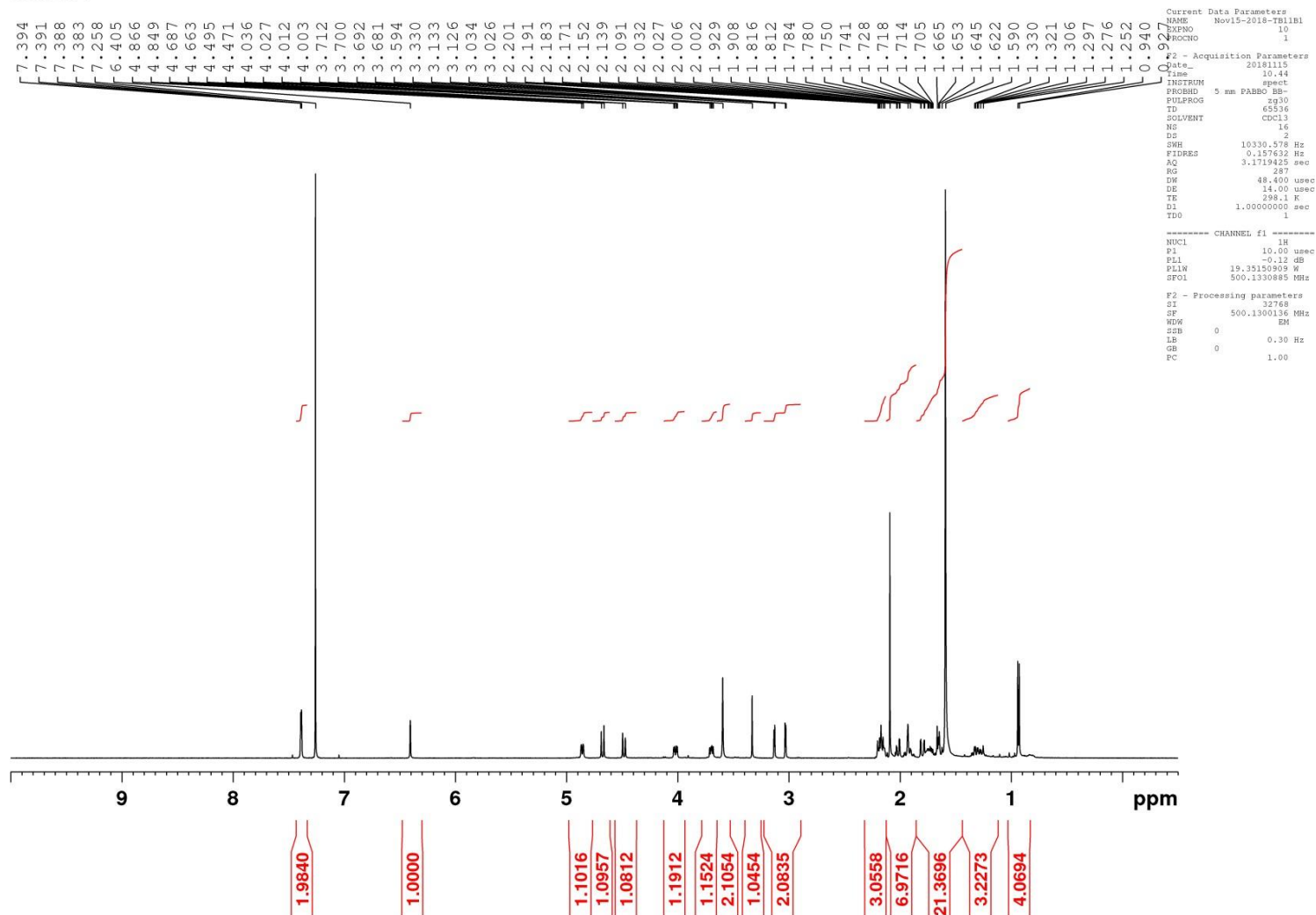
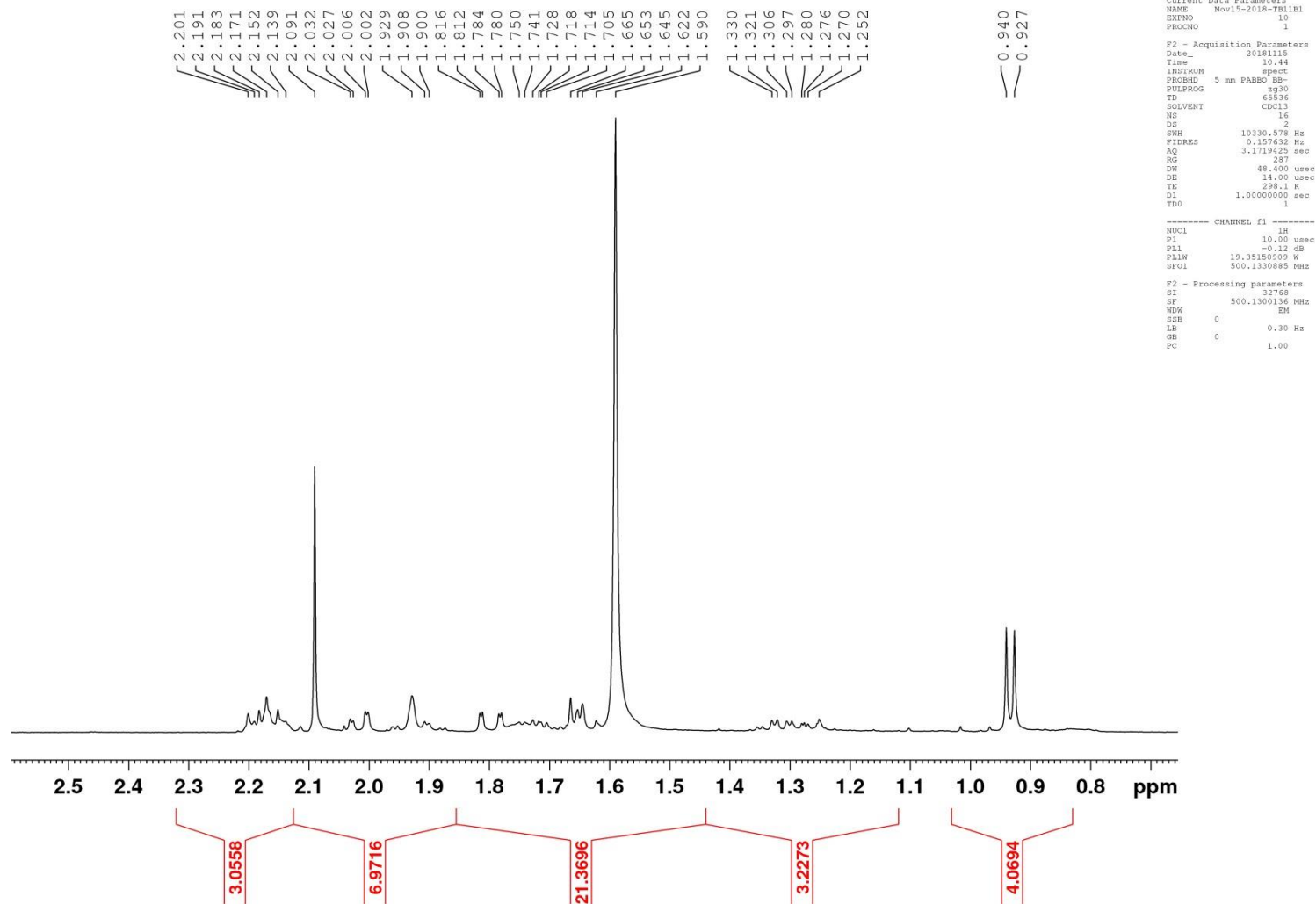


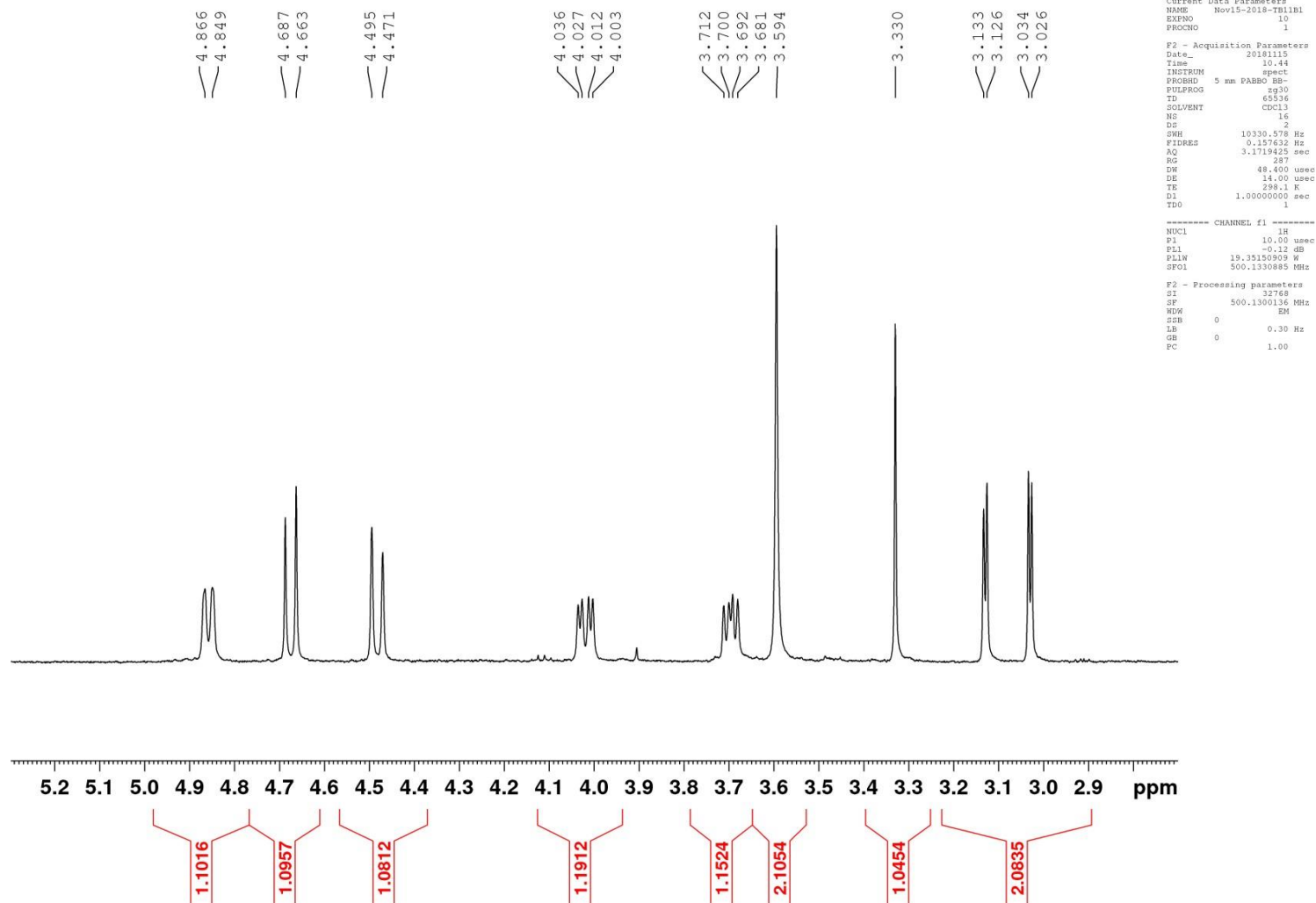
Figure S114.  $^1\text{H}$  NMR spectrum of **14** in  $\text{CDCl}_3$ .

TB11B1



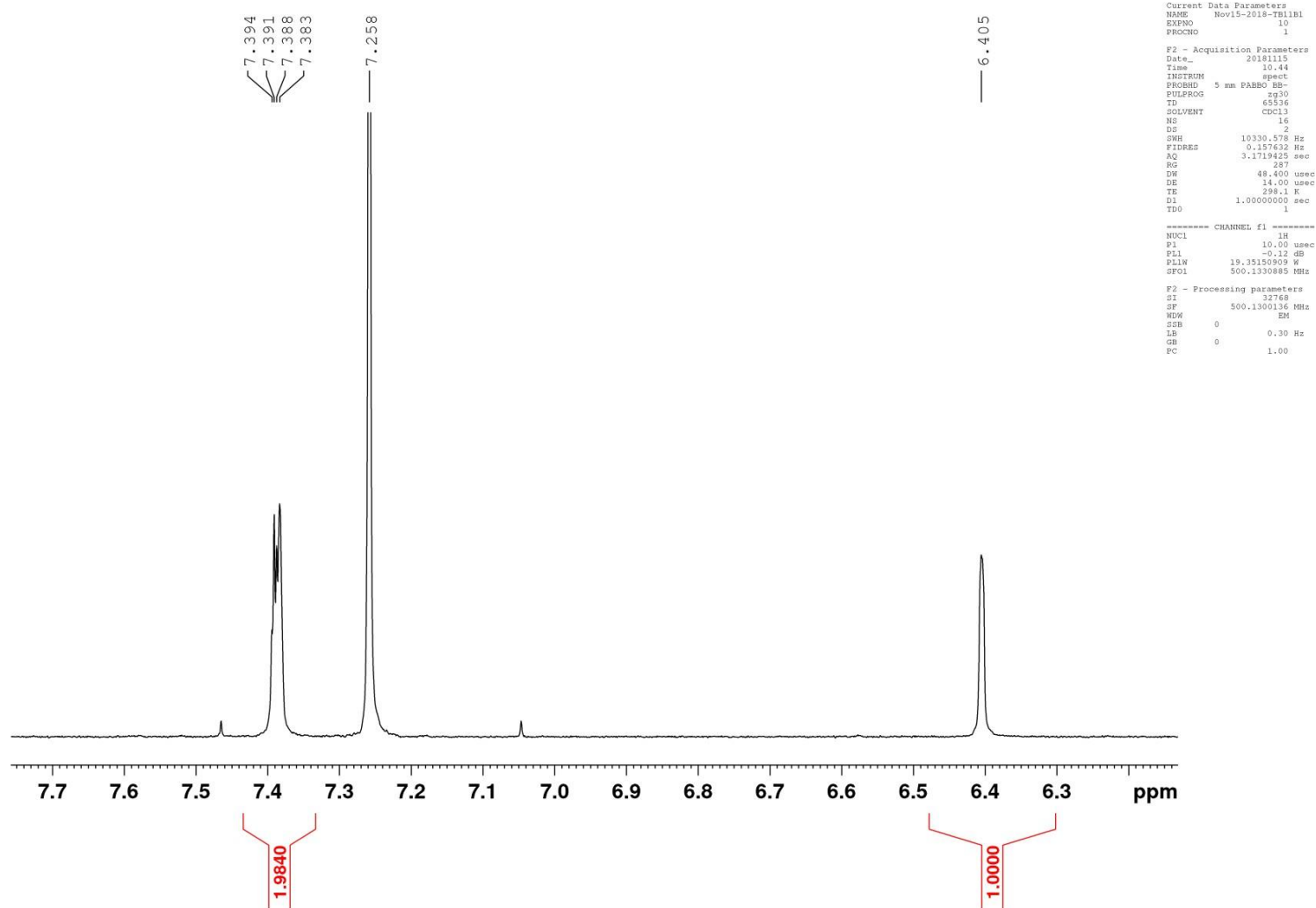
**Figure S115.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.7 –  $\delta$  2.5) of **14** in  $\text{CDCl}_3$ .

TB11B1

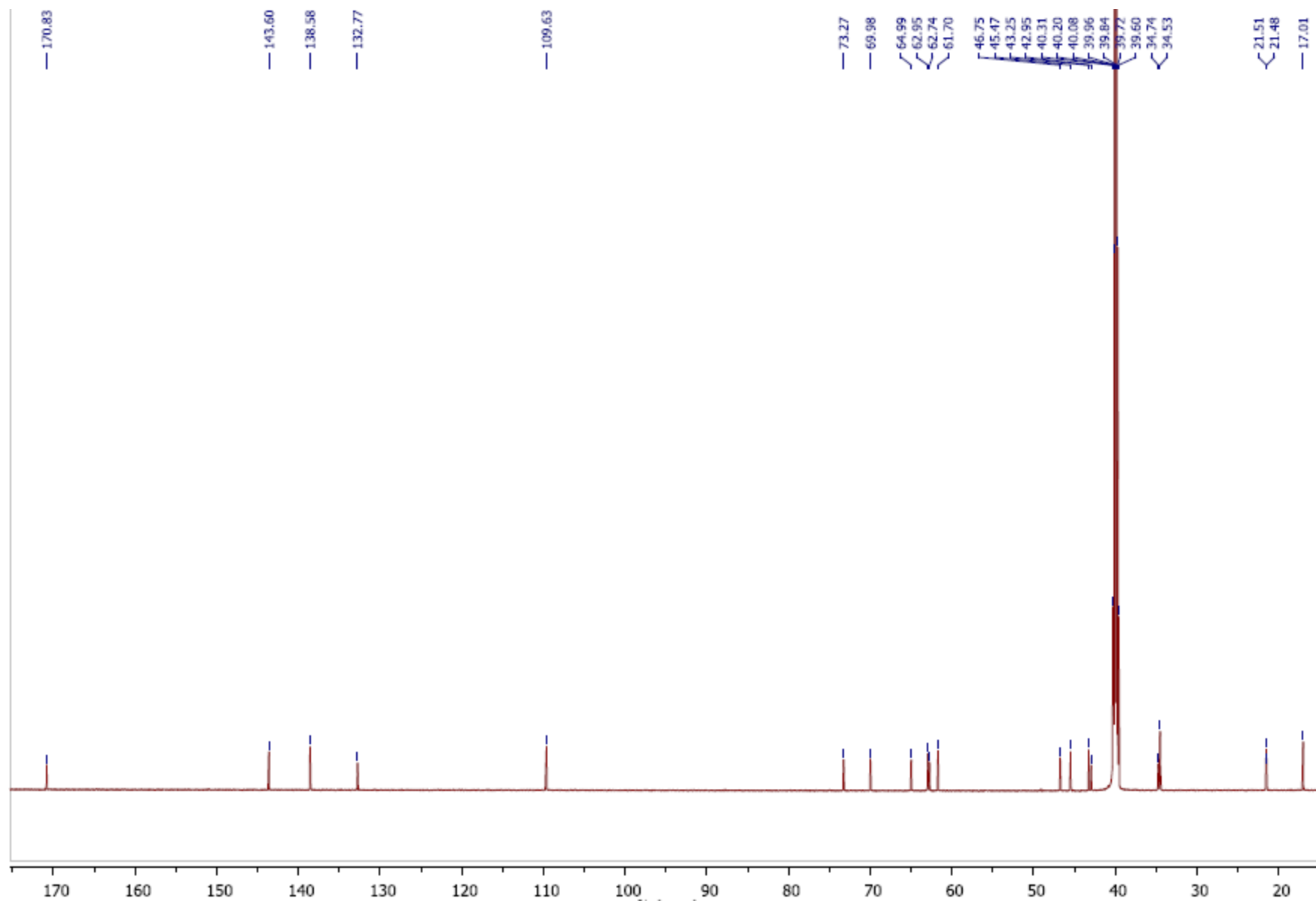


**Figure S116.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  2.8 –  $\delta$  5.2) of **14** in  $\text{CDCl}_3$ .

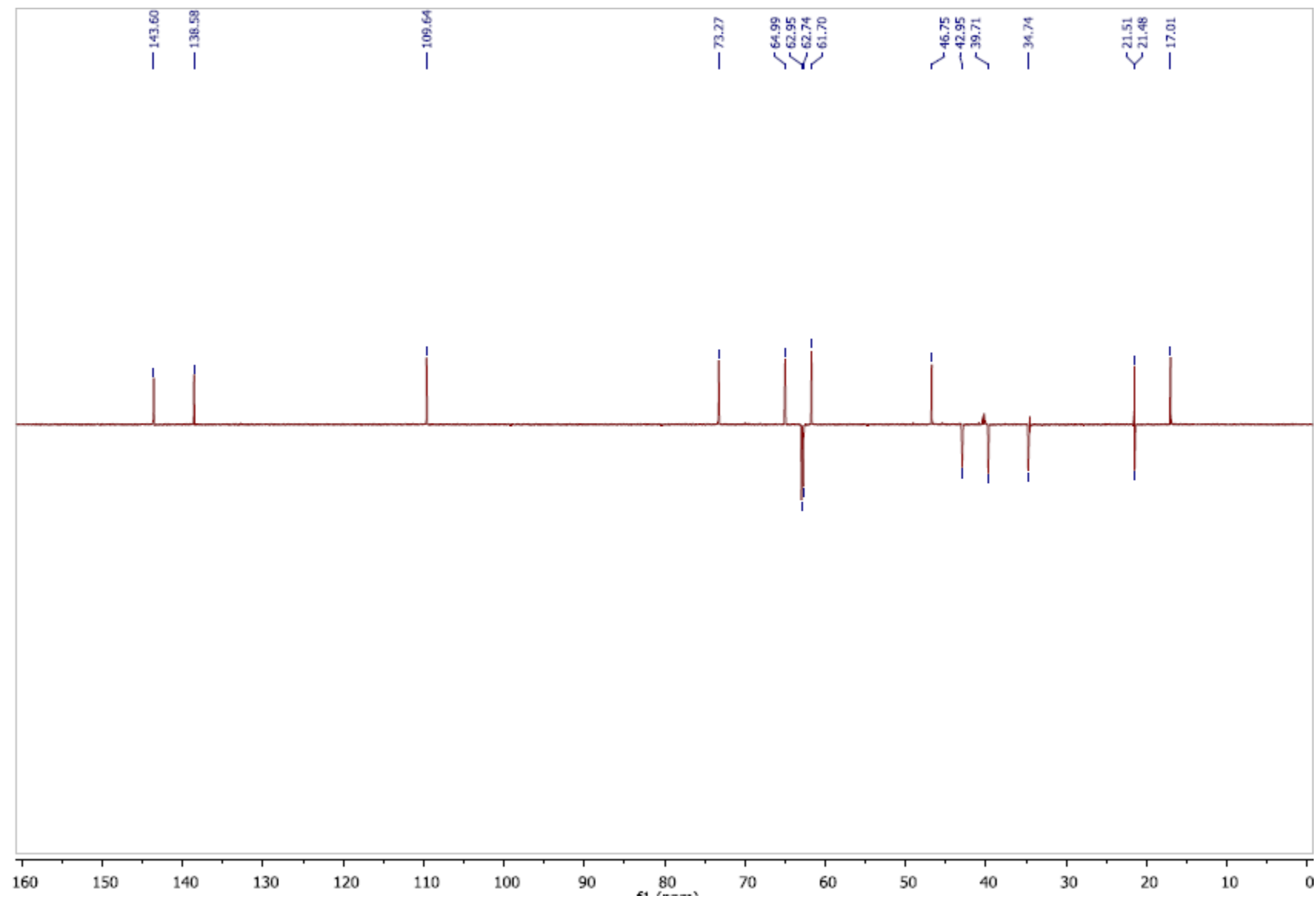
TB11B1



**Figure S117.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  6.2 –  $\delta$  7.7) of **14** in  $\text{CDCl}_3$ .

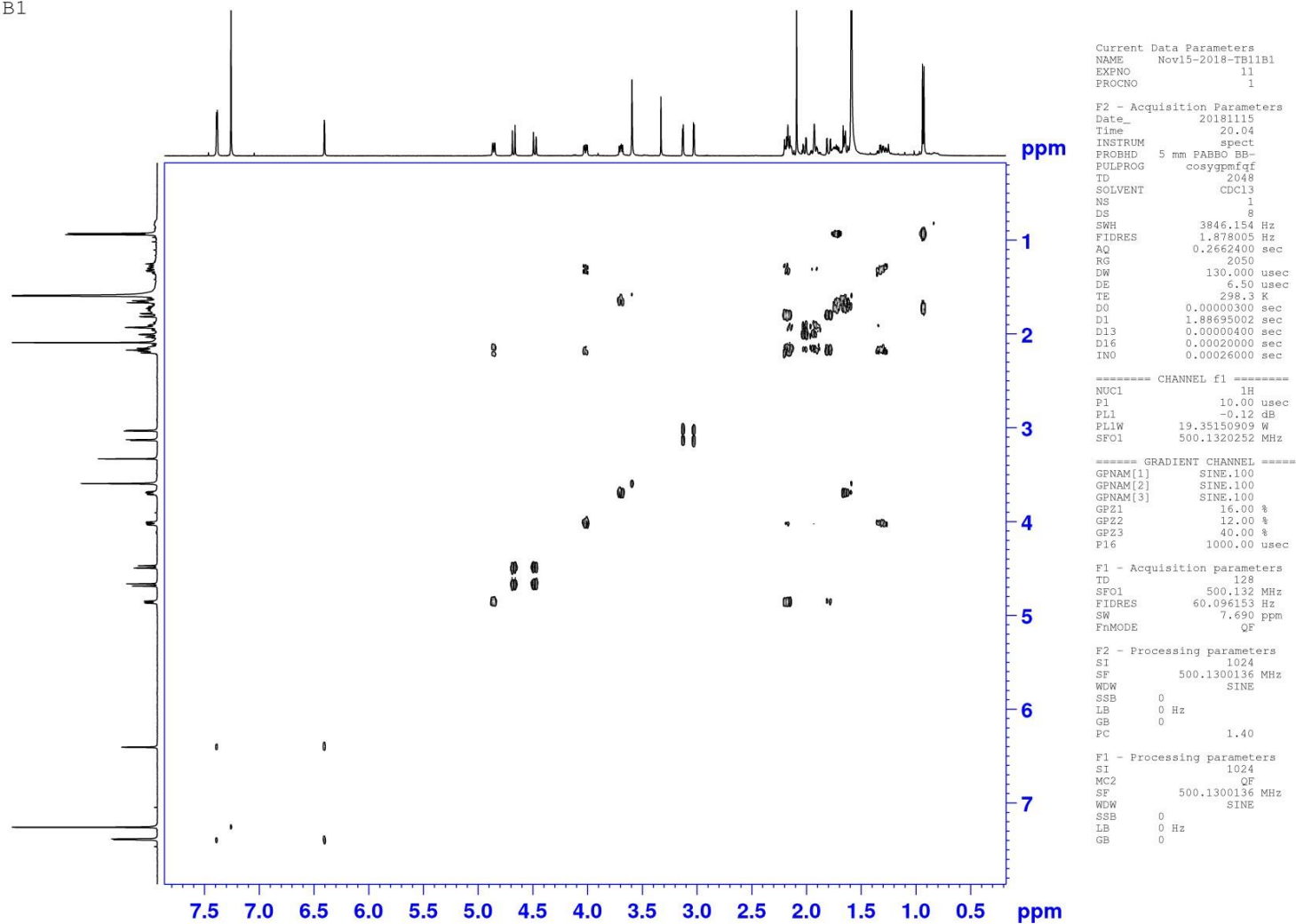


**Figure S118.** <sup>13</sup>C NMR spectrum of **14** in (CD<sub>3</sub>)<sub>2</sub>SO.



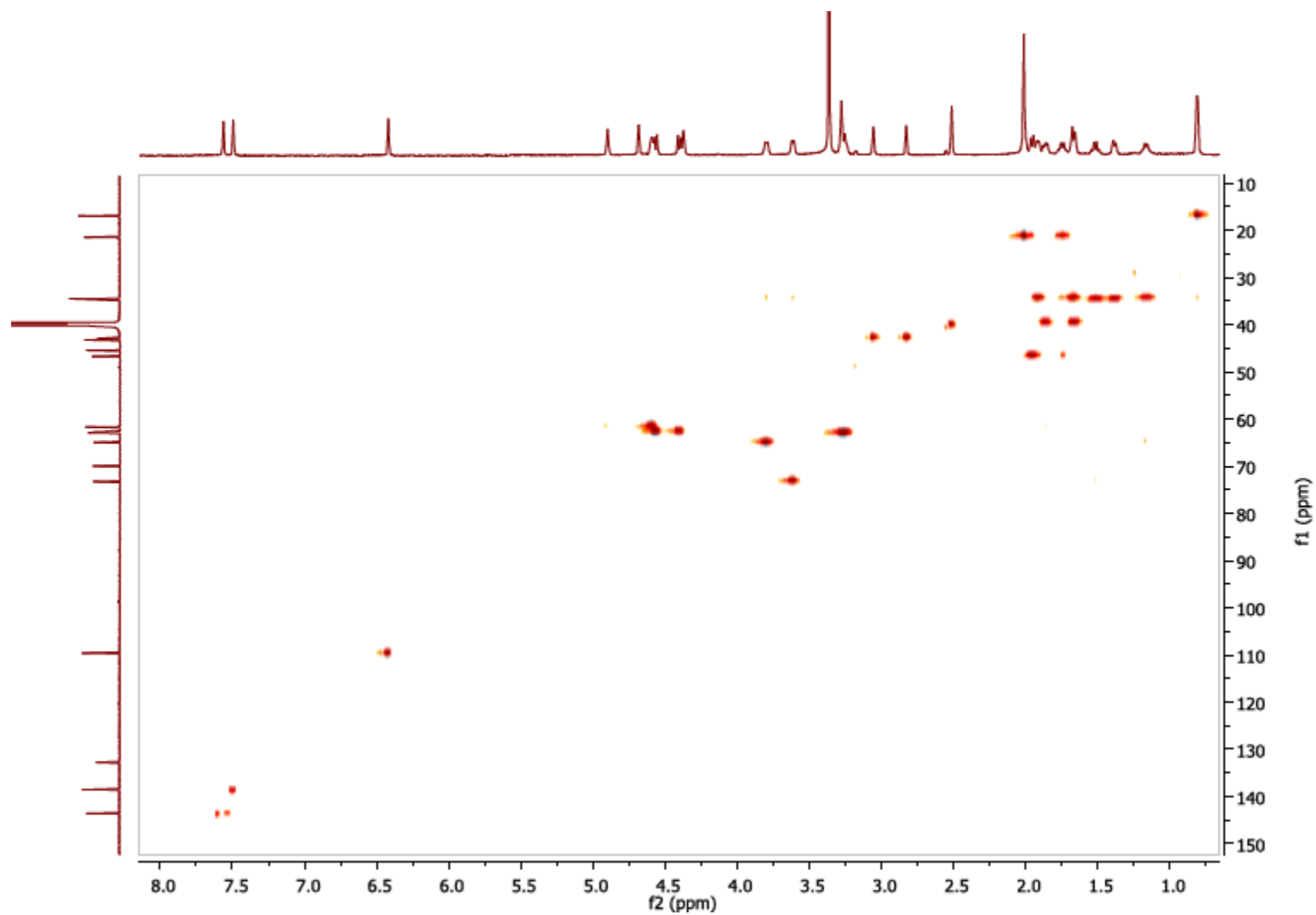
**Figure S119.** 135DEPT NMR spectrum of **14** in  $(\text{CD}_3)_2\text{SO}$ .

TB11B1

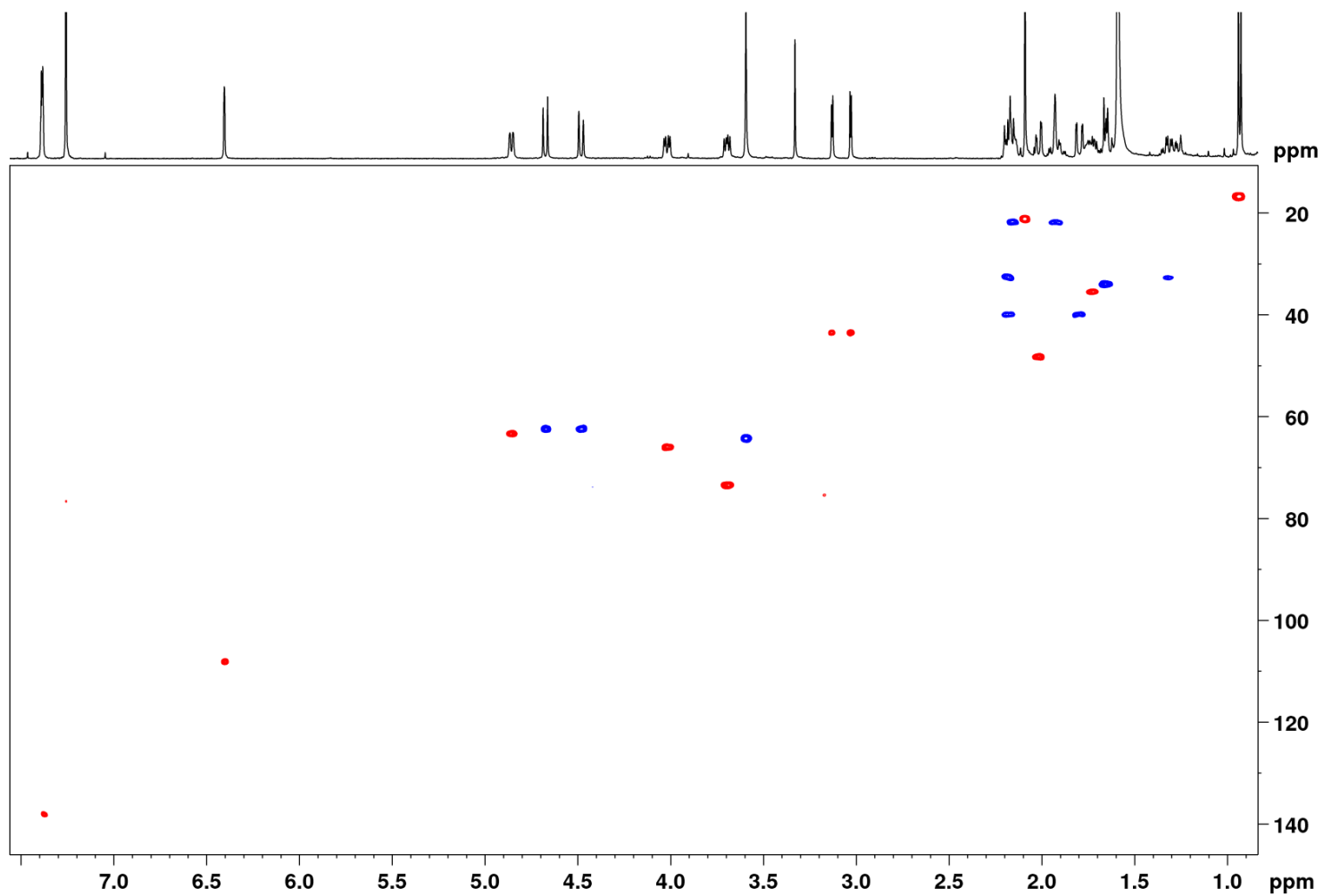


**Figure S120.** COSY  $^1\text{H}$  NMR spectrum of **14** in  $\text{CDCl}_3$ .

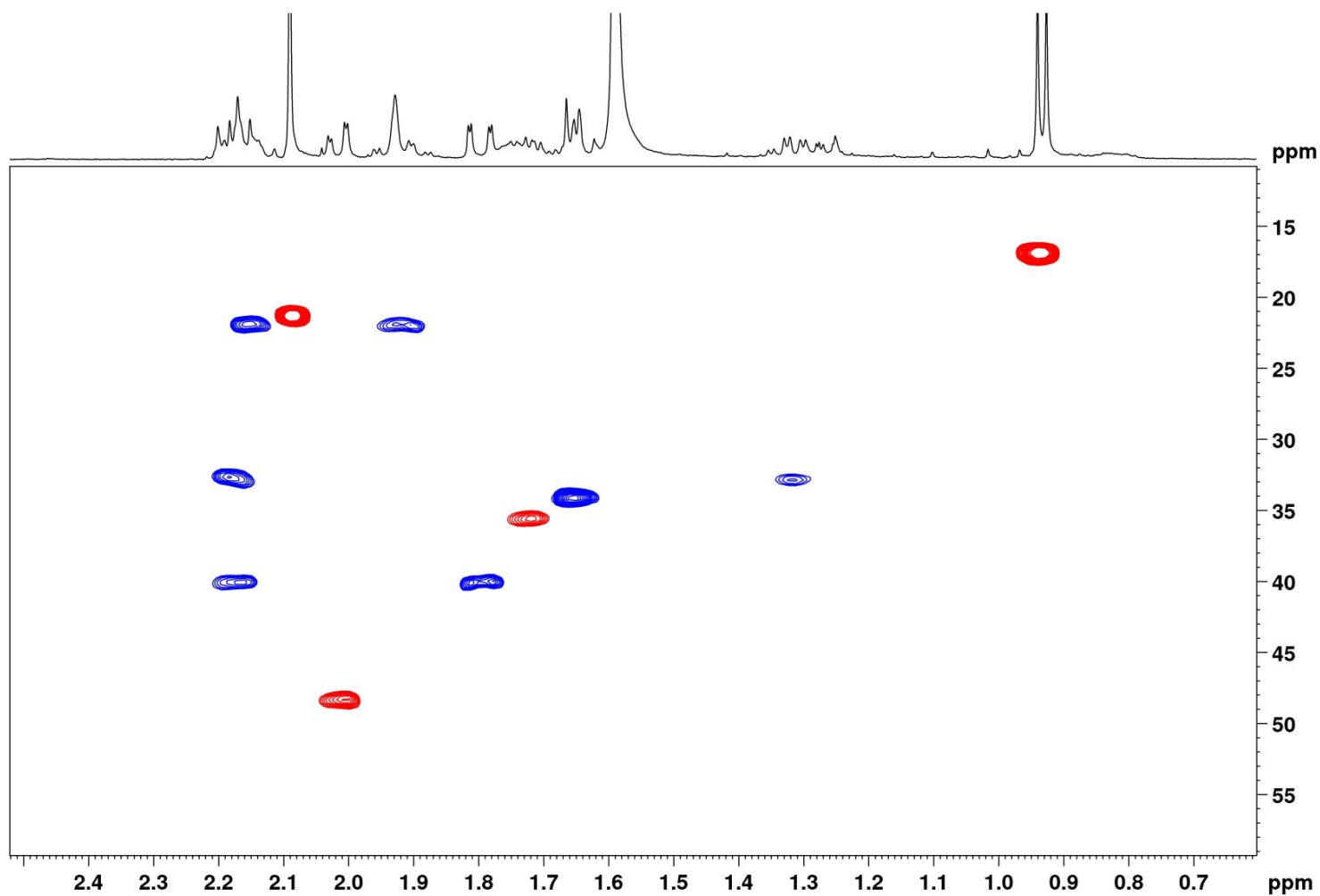




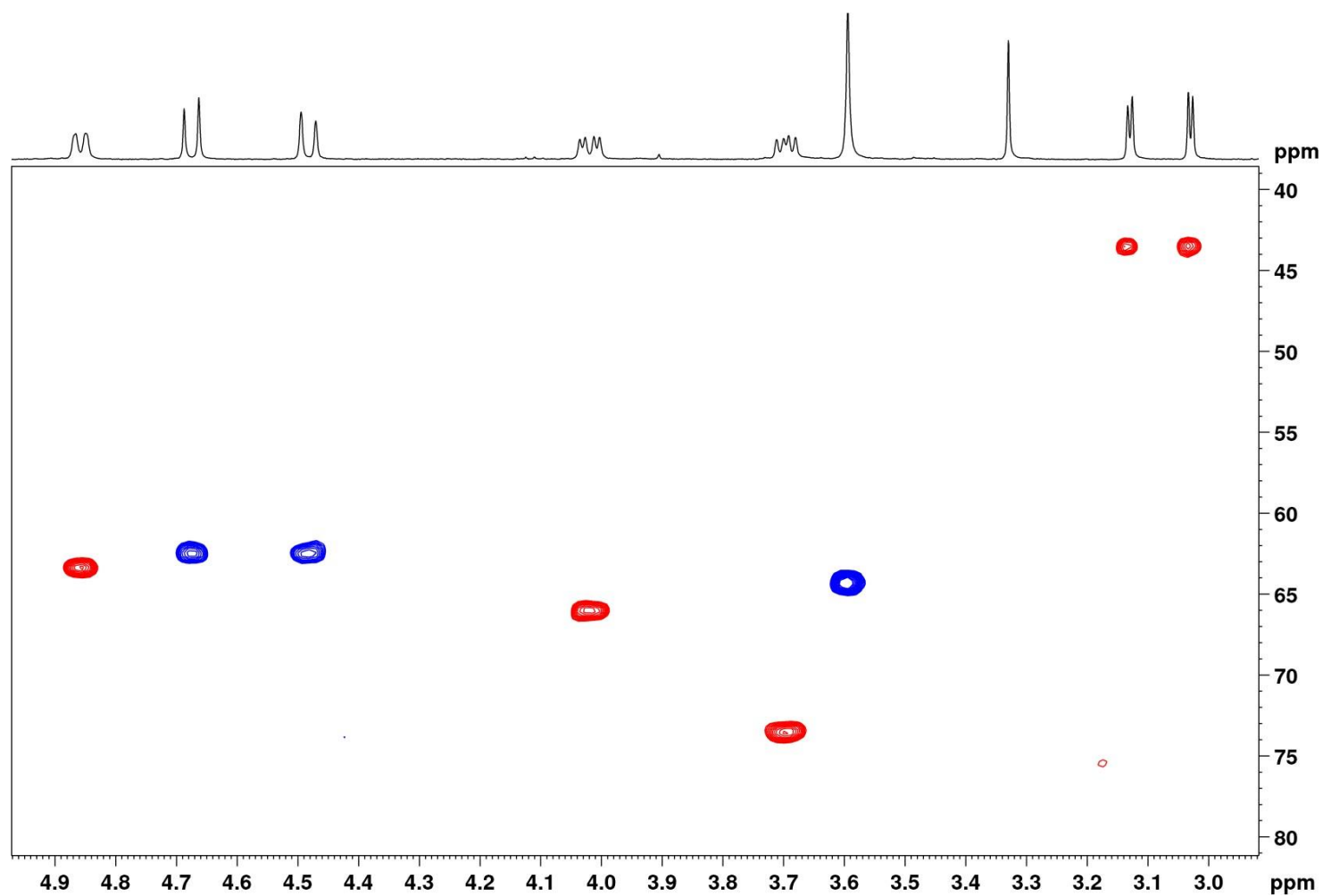
**Figure S121.** HSQC NMR spectrum of **14** in  $(\text{CD}_3)_2\text{SO}$ .



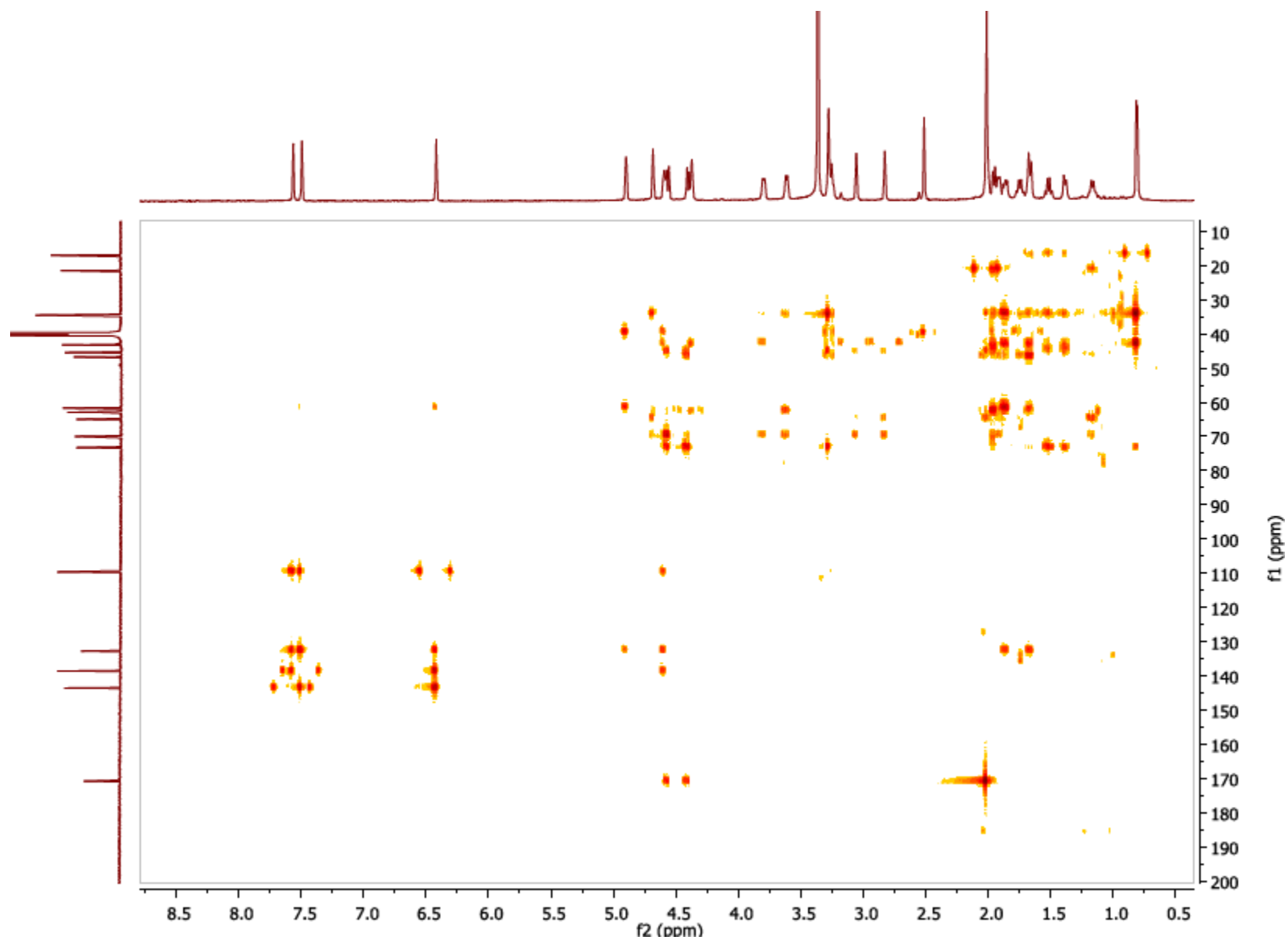
**Figure S122.** HSQC  $^1\text{H}$  NMR spectrum of **14** in  $\text{CDCl}_3$ .



**Figure S123.** Expansion of part of HSQC NMR spectrum ( $\delta$  0.7 –  $\delta$  2.5) of **14** in CDCl<sub>3</sub>.

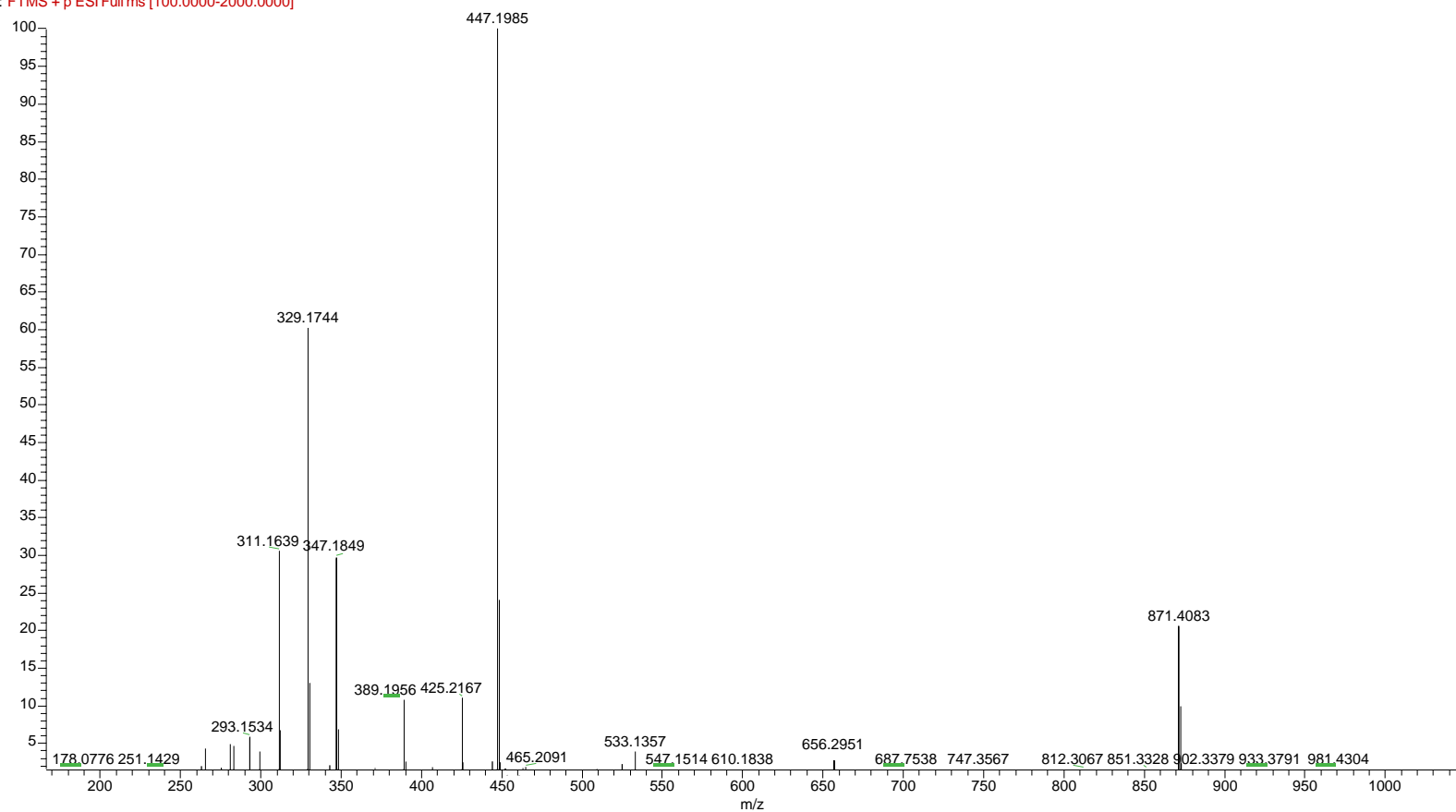


**Figure S124.** Expansion of part of HSQC NMR spectrum ( $\delta$  3.0 –  $\delta$  4.9) of **14** in  $\text{CDCl}_3$ .



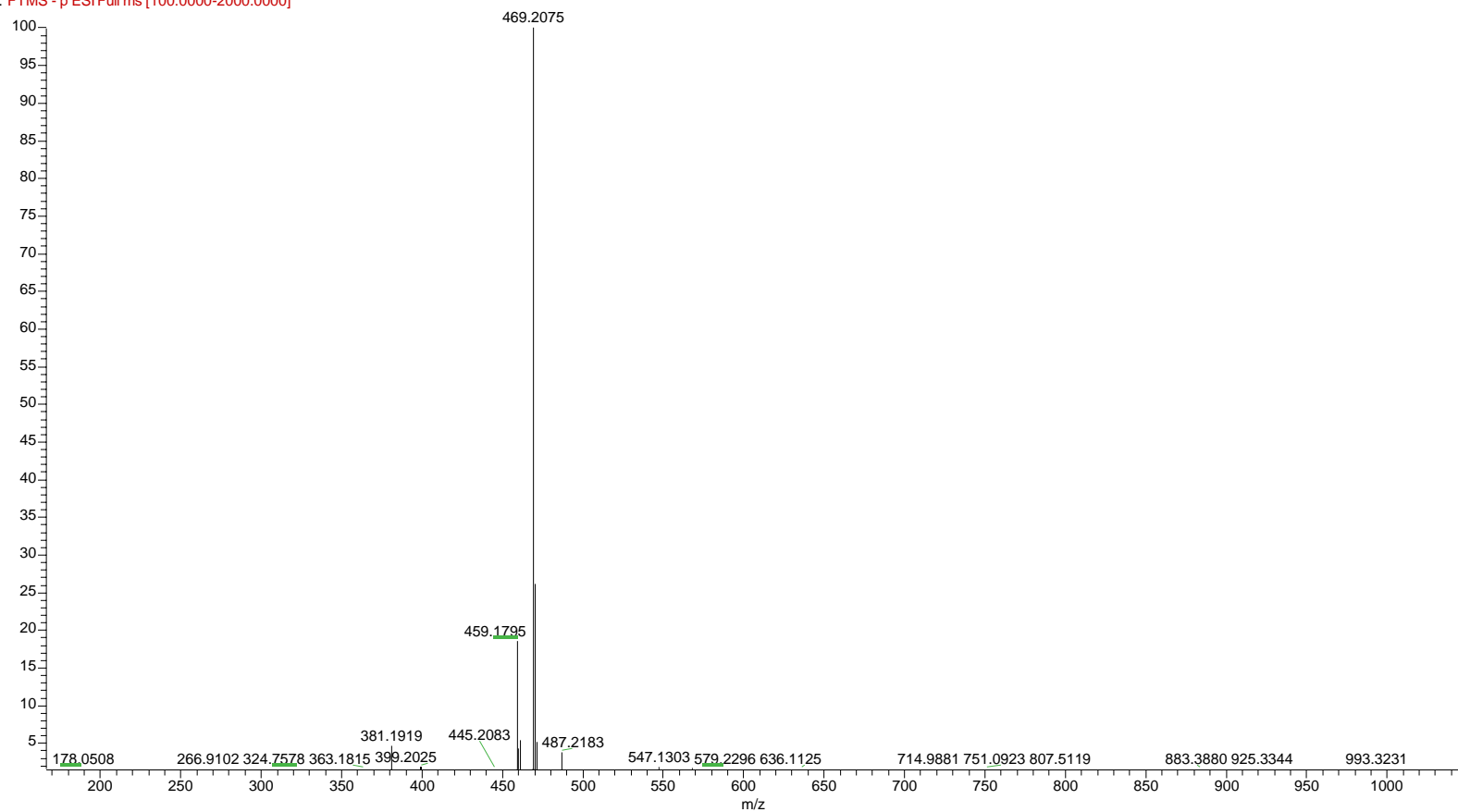
**Figure S125.** HMBC NMR spectrum of **14** in  $(\text{CD}_3)_2\text{SO}$ .

R3 #249-261 RT: 3.56-3.73 AV: 7 NL: 3.20E7  
F: FTMS + p ESI Full ms [100.0000-2000.0000]

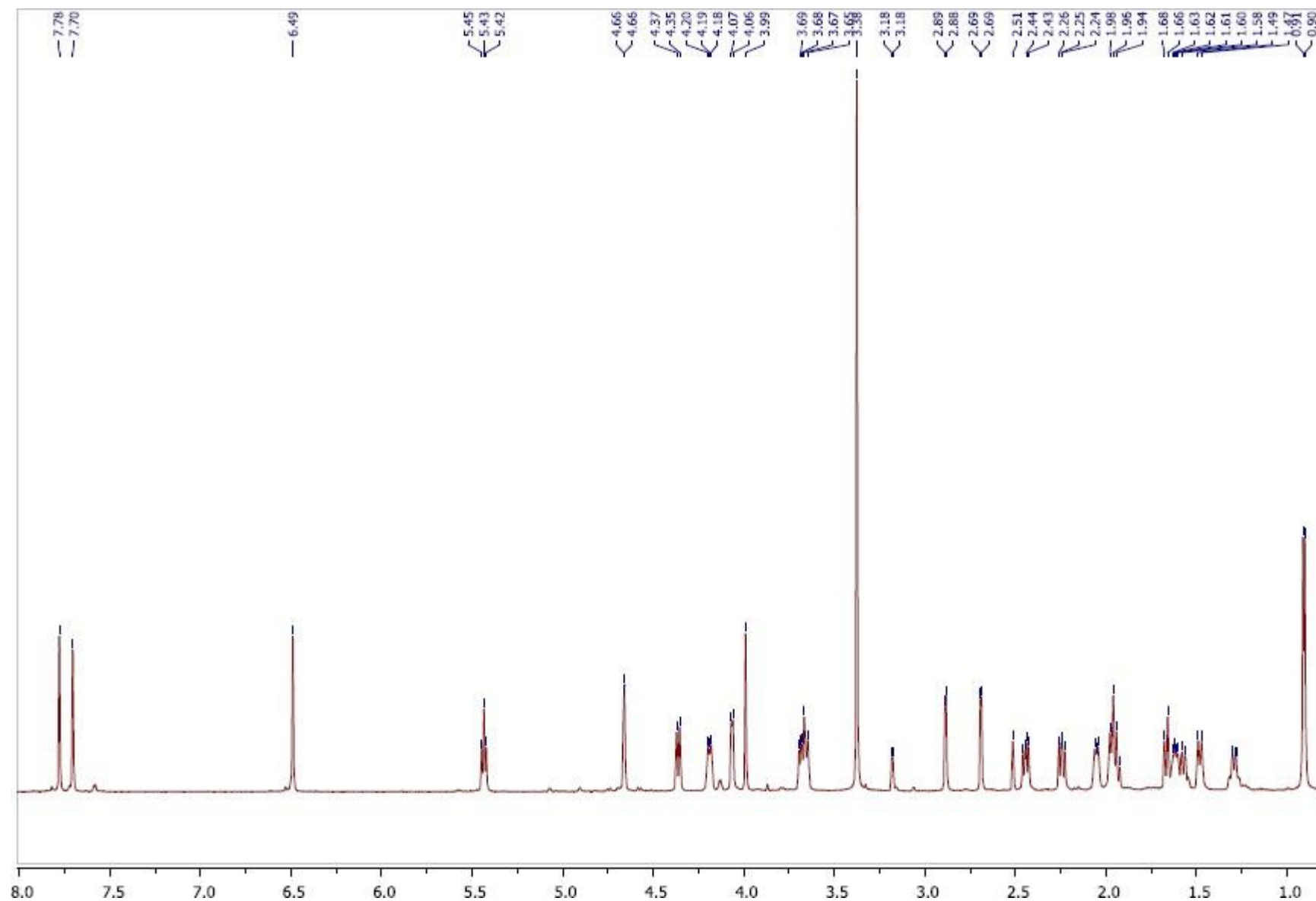


**Figure S126.** Positive-ion HRESIMS of **14**.

R3 #249-261 RT: 3.58-3.72 AV: 6 NL: 1.29E7  
F: FTMS - p ESI Full ms [100.0000-2000.0000]

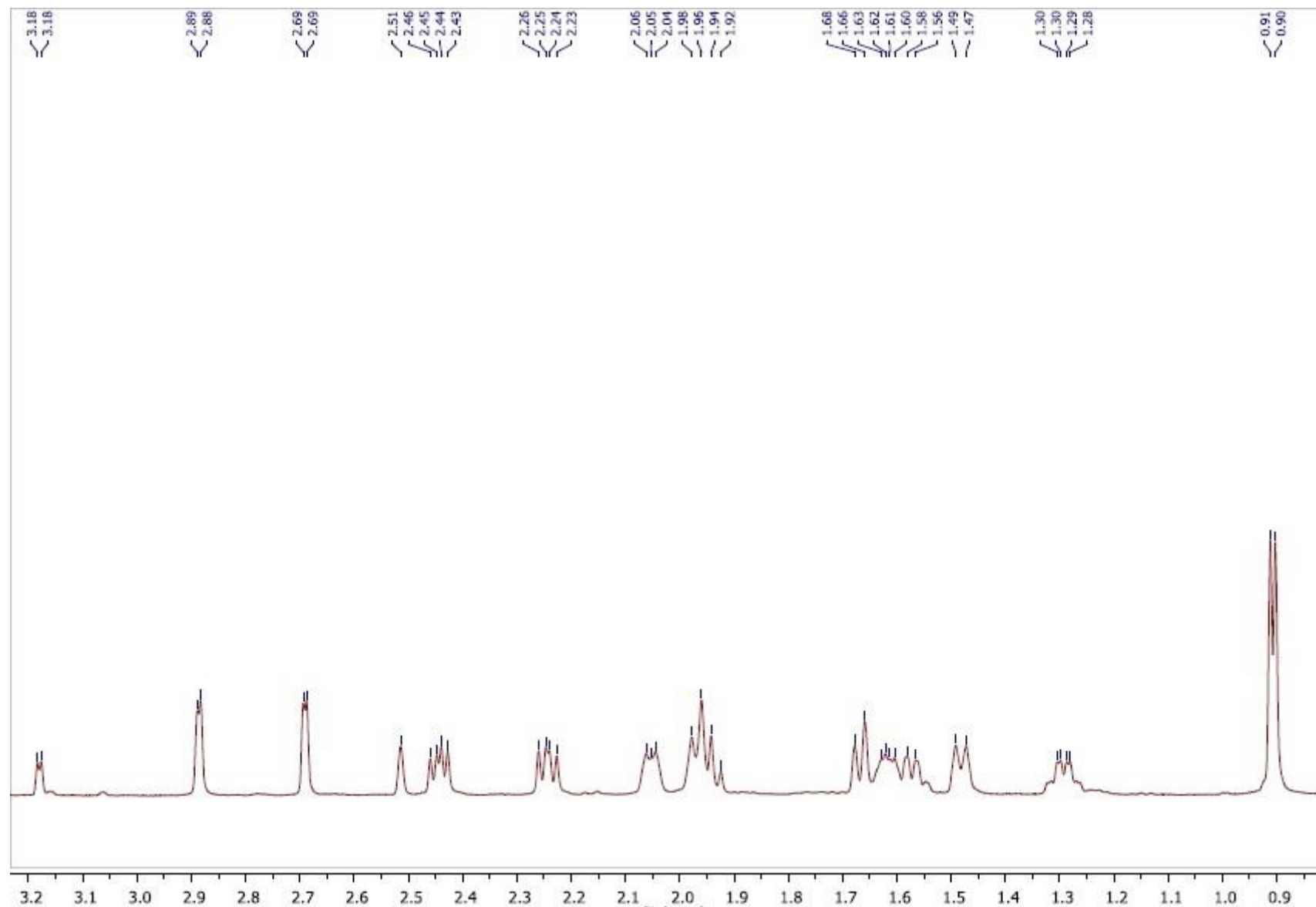


**Figure S127.** Negative-ion HRESIMS of **14**.

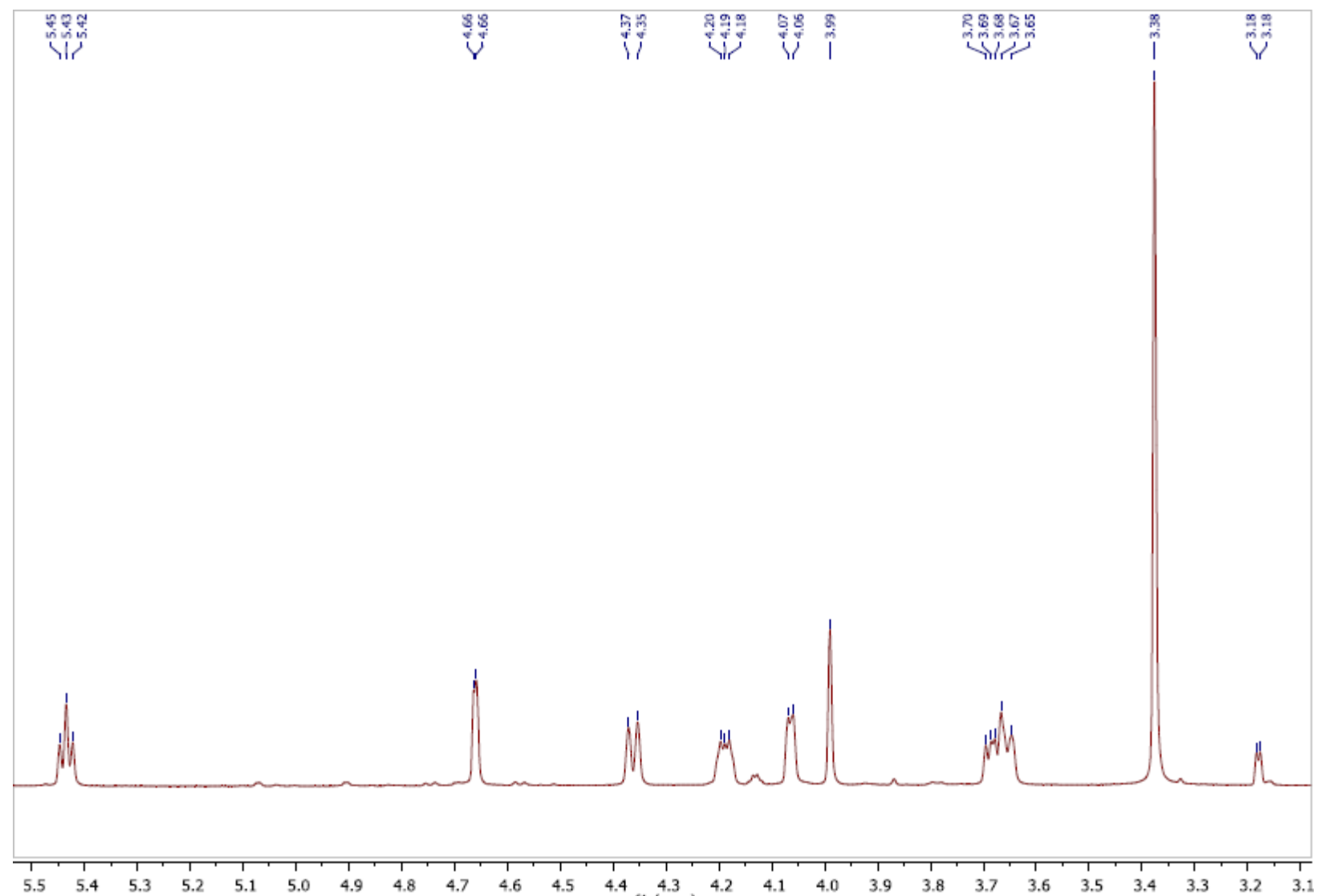


**Figure S128.**  $^1\text{H}$  NMR spectrum of **15** in  $(\text{CD}_3)_2\text{SO}$ .



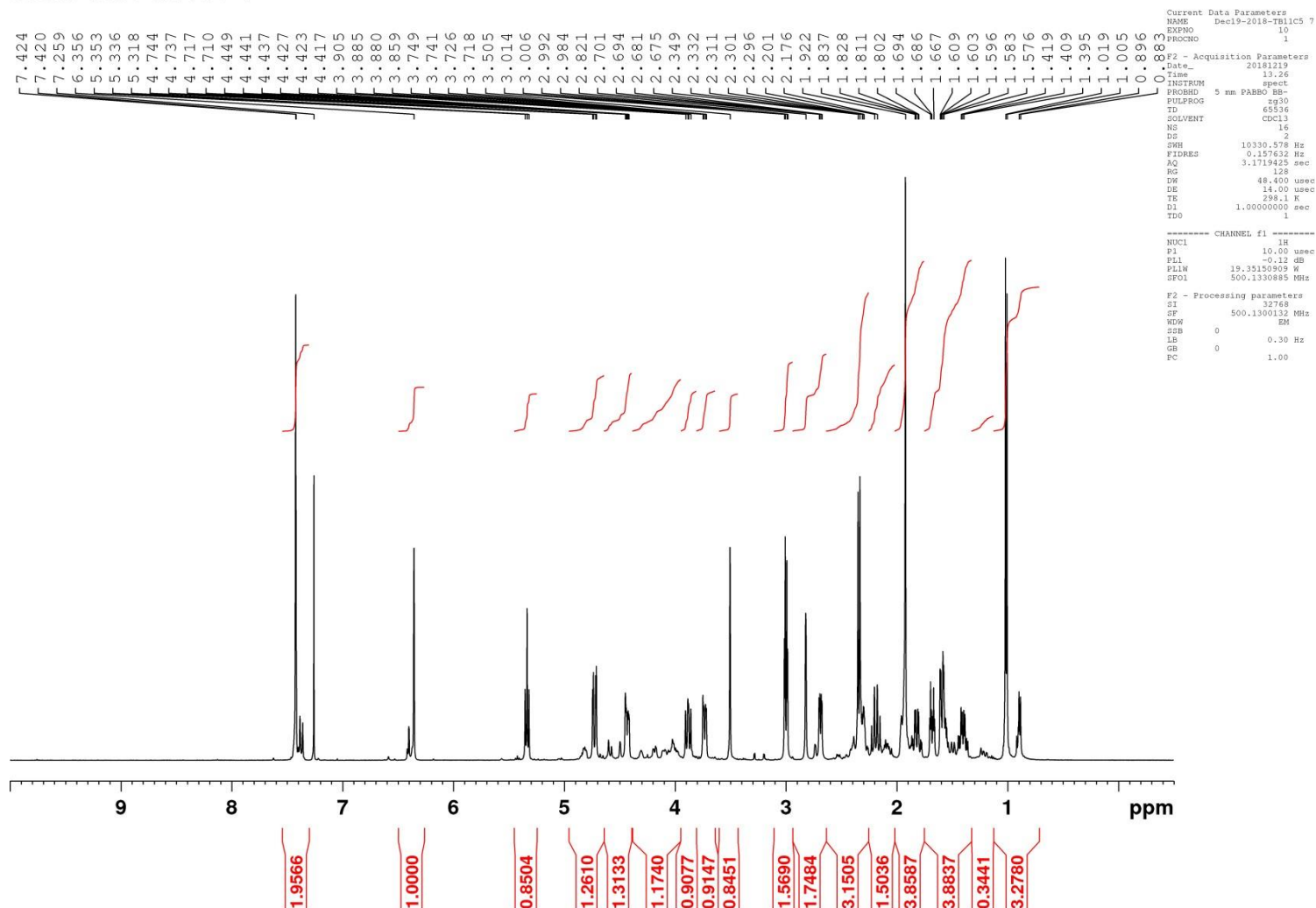


**Figure S129.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.8 –  $\delta$  3.2) of **15** in  $(\text{CD}_3)_2\text{SO}$ .



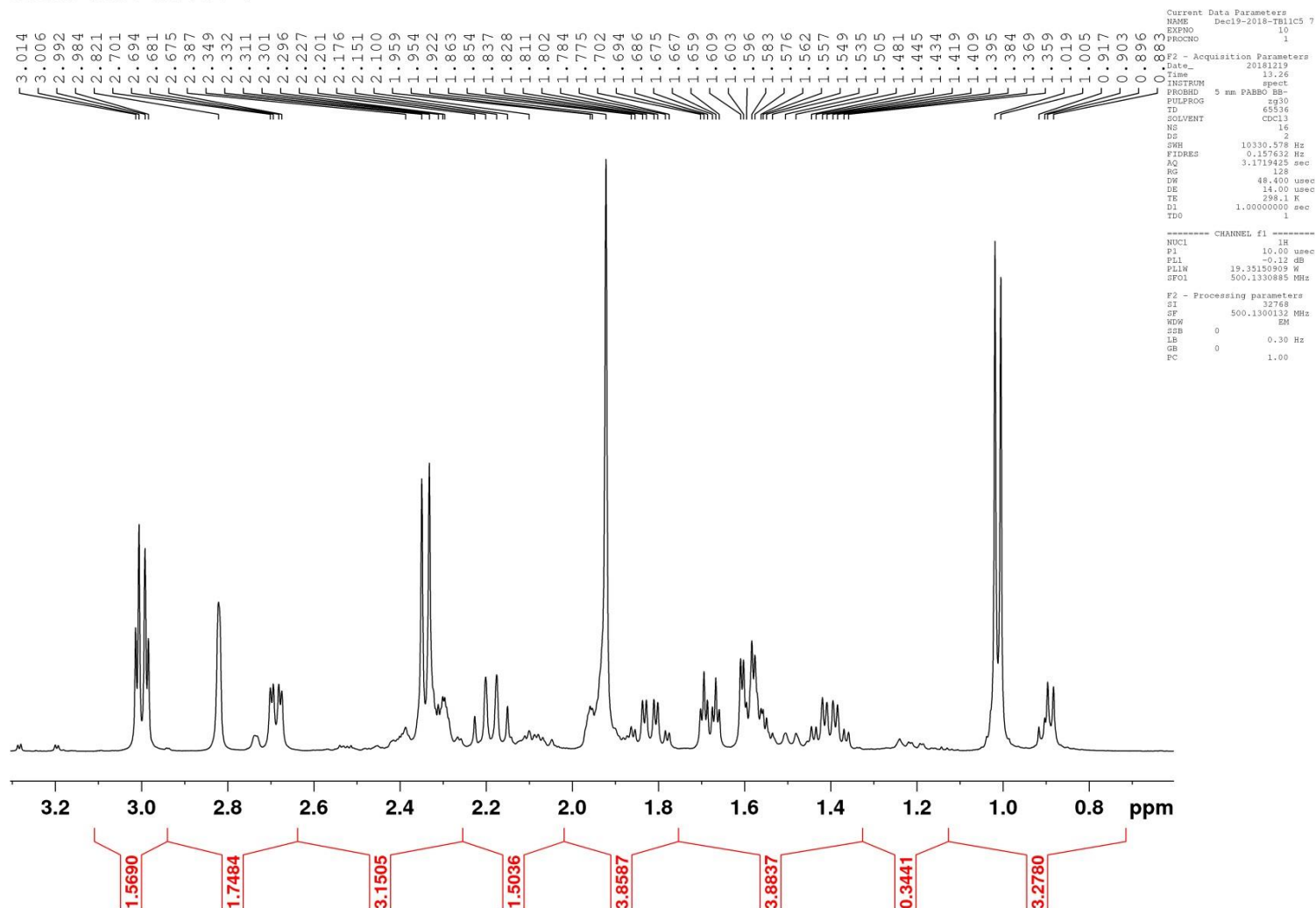
**Figure S130.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  3.1 –  $\delta$  5.5) of **15** in  $(\text{CD}_3)_2\text{SO}$ .

Dec19-2018-TB11C5 7



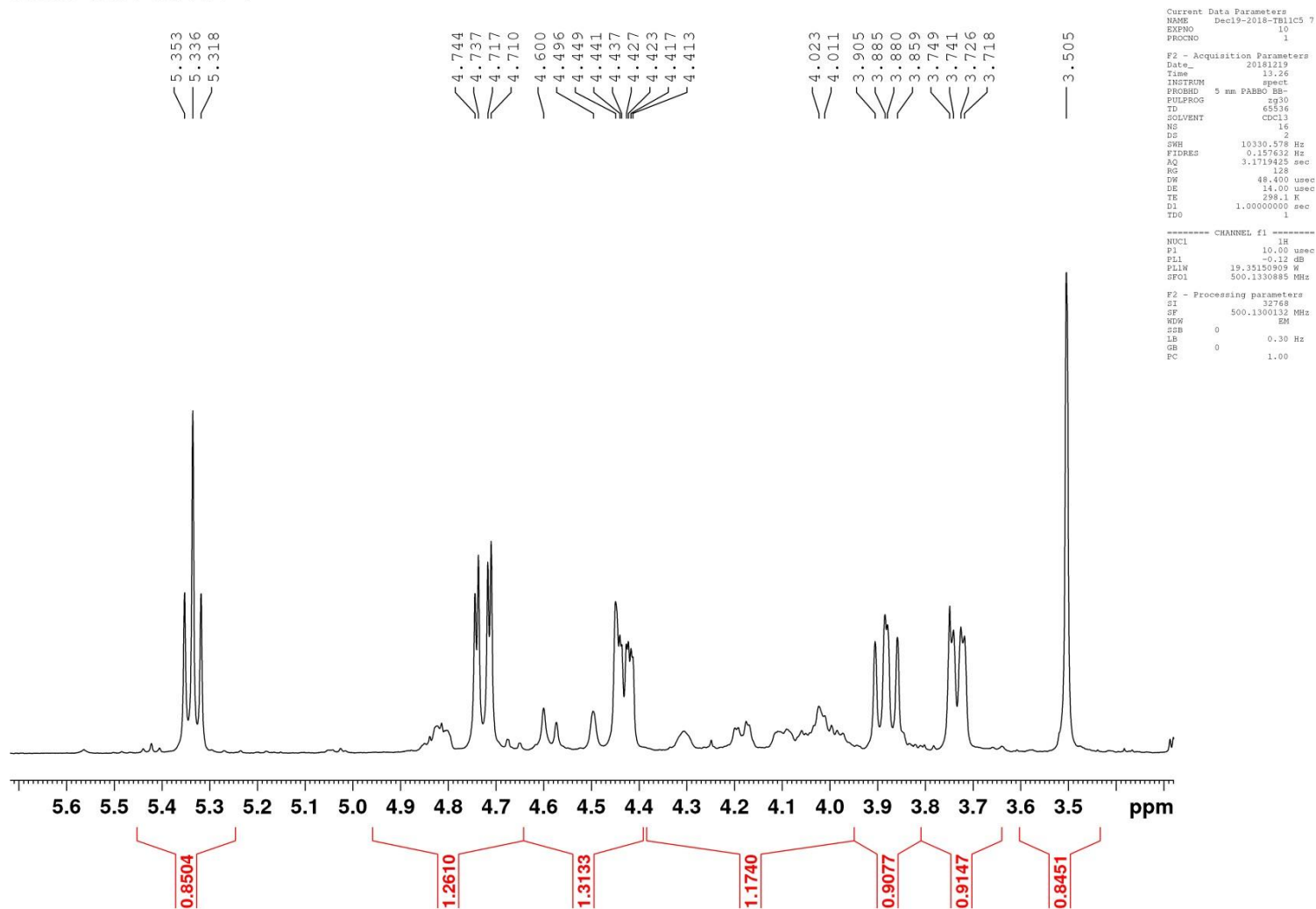
**Figure S131.**  $^1\text{H}$  NMR spectrum of **15** in  $\text{CDCl}_3$ .

Dec19-2018-TB11C5 7



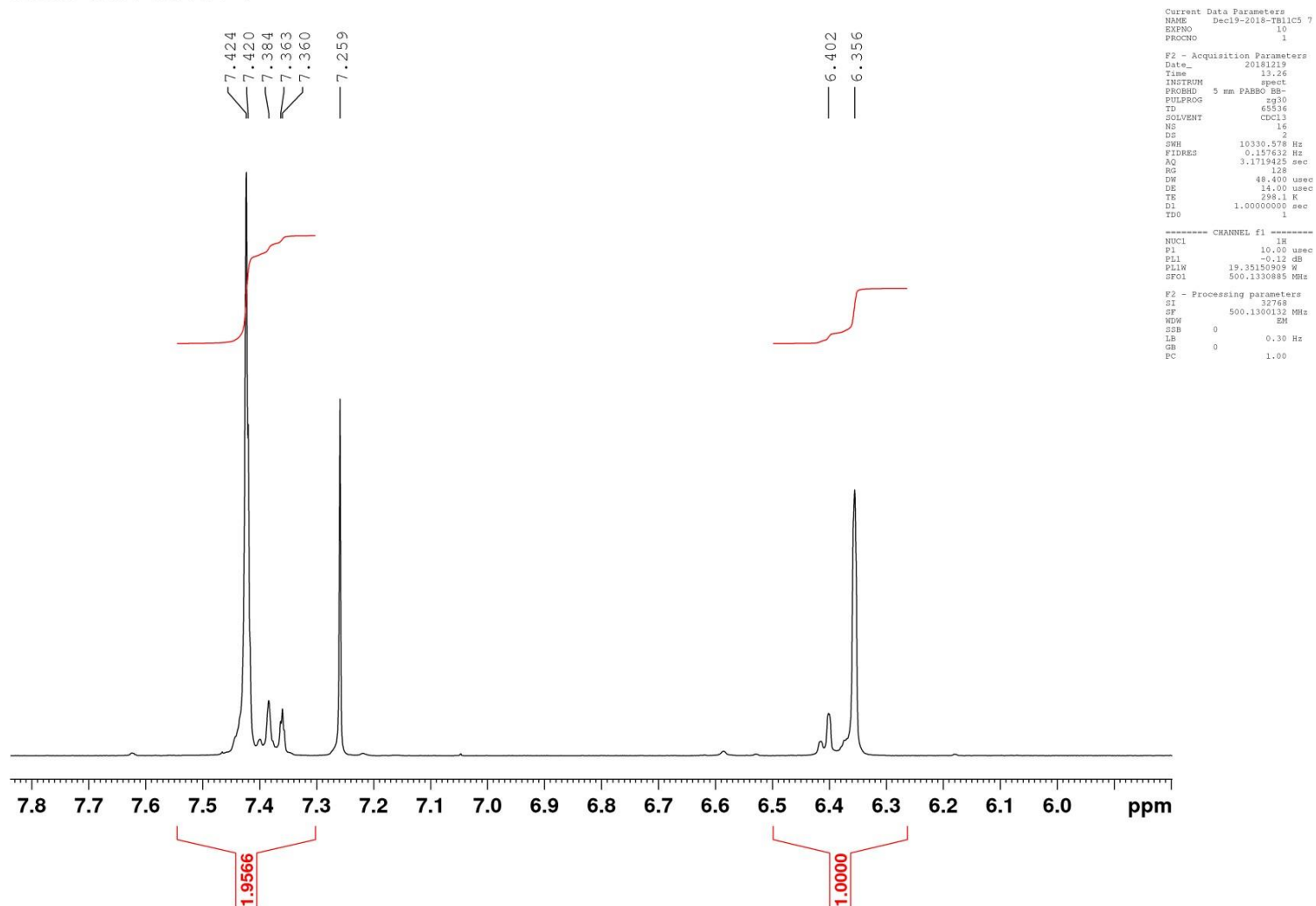
**Figure S132.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.8 –  $\delta$  3.2) of **15** in  $\text{CDCl}_3$ .

Dec19-2018-TB11C5 7

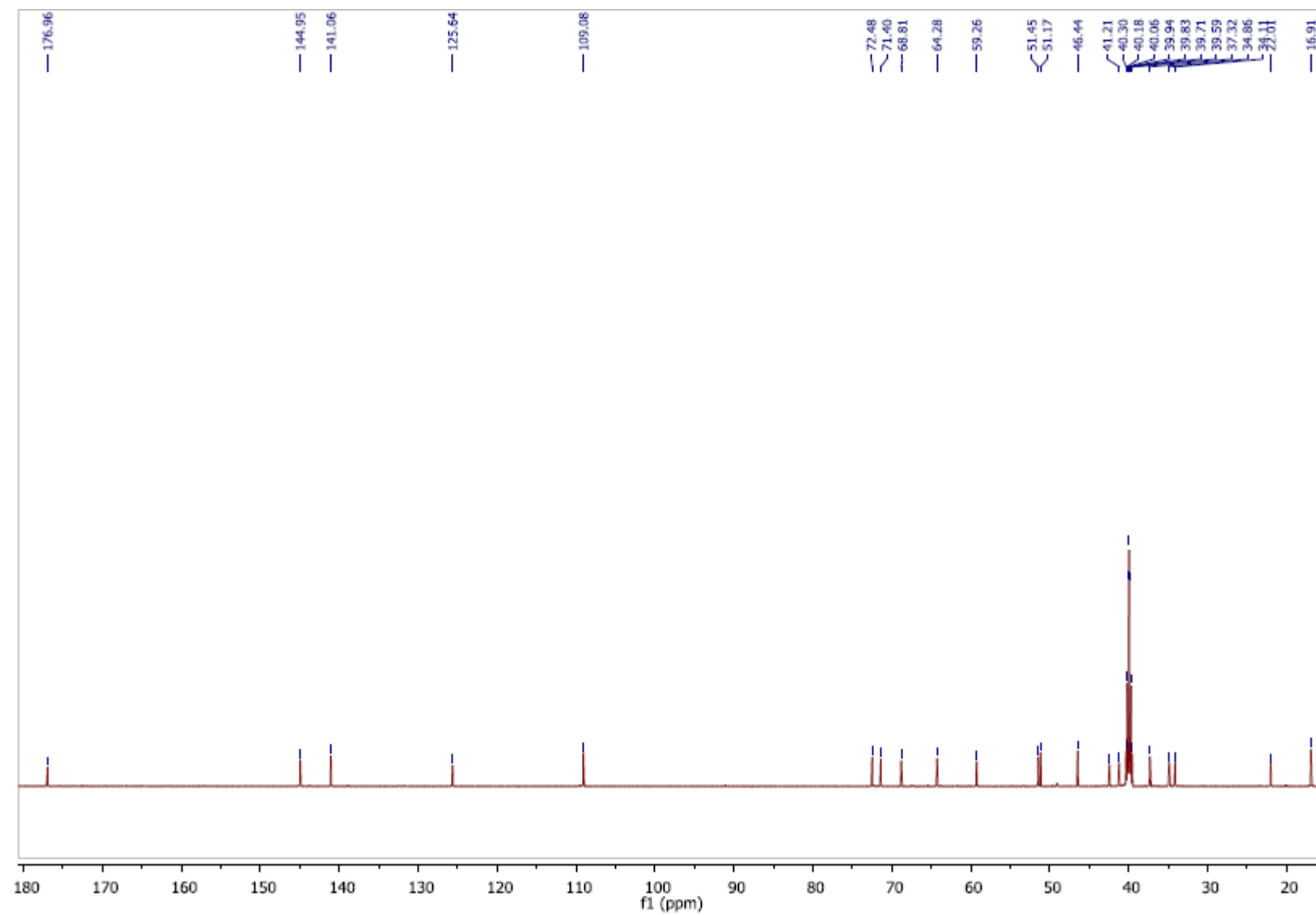


**Figure S133.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  3.3 –  $\delta$  5.6) of **15** in  $\text{CDCl}_3$ .

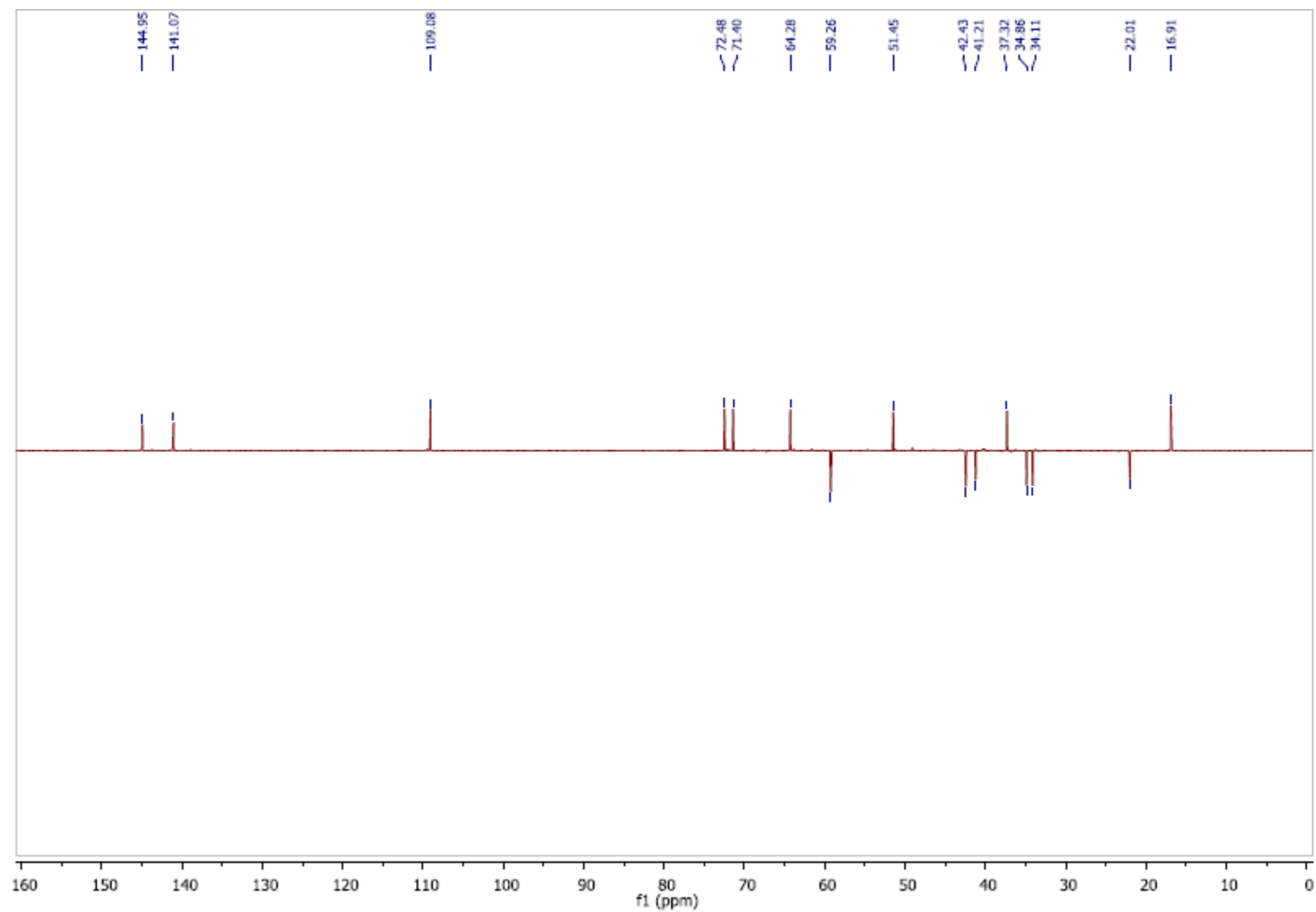
Dec19-2018-TB11C5 7



**Figure S134.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  5.8 –  $\delta$  7.8) of **15** in  $\text{CDCl}_3$ .



**Figure S135.**  $^{13}\text{C}$  NMR spectrum of **15** in  $(\text{CD}_3)_2\text{SO}$ .



**Figure S136.** 135DEPT NMR spectrum of **15** in  $(\text{CD}_3)_2\text{SO}$ .



Dec19-2018-TB11C5 7

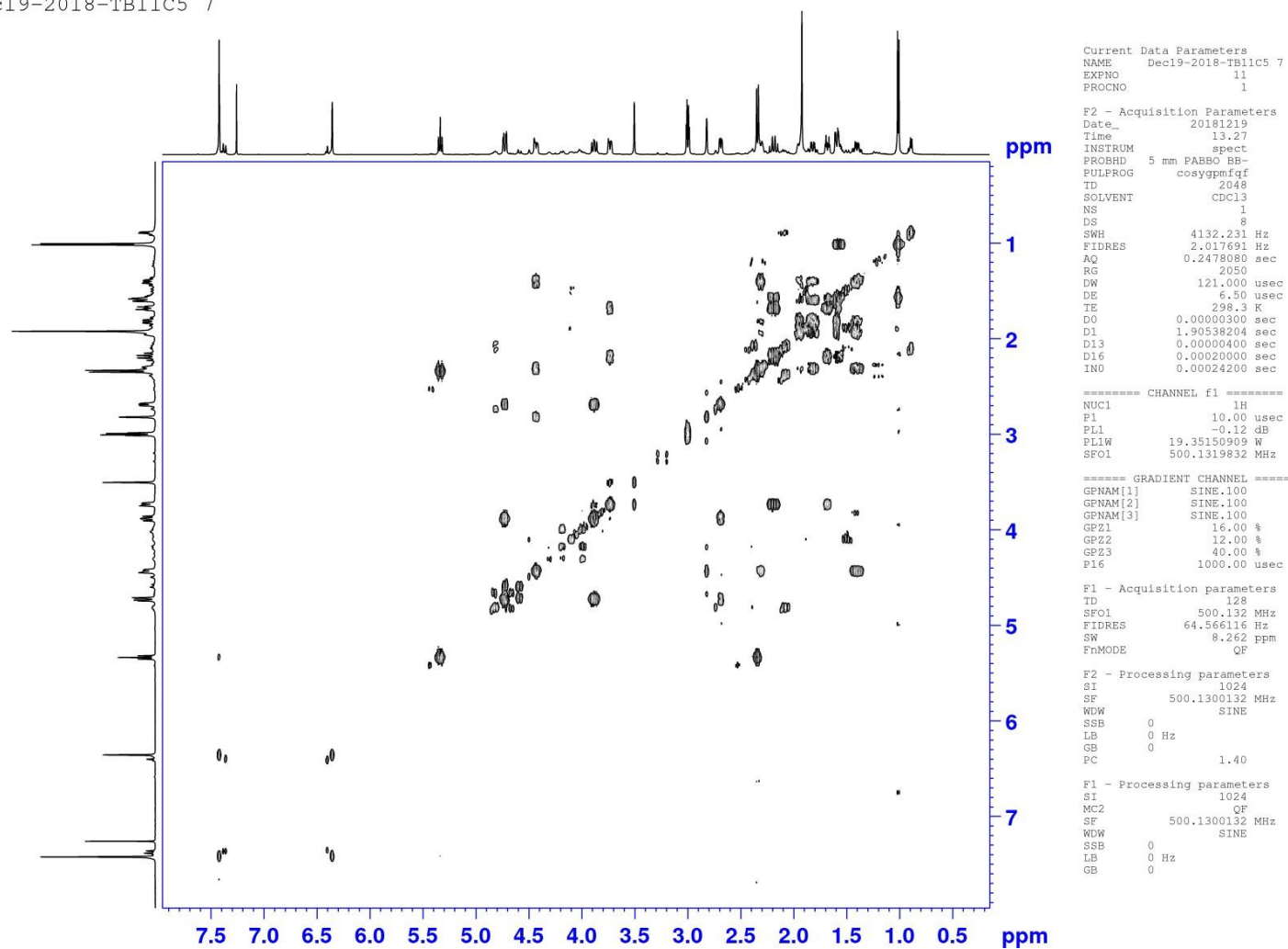
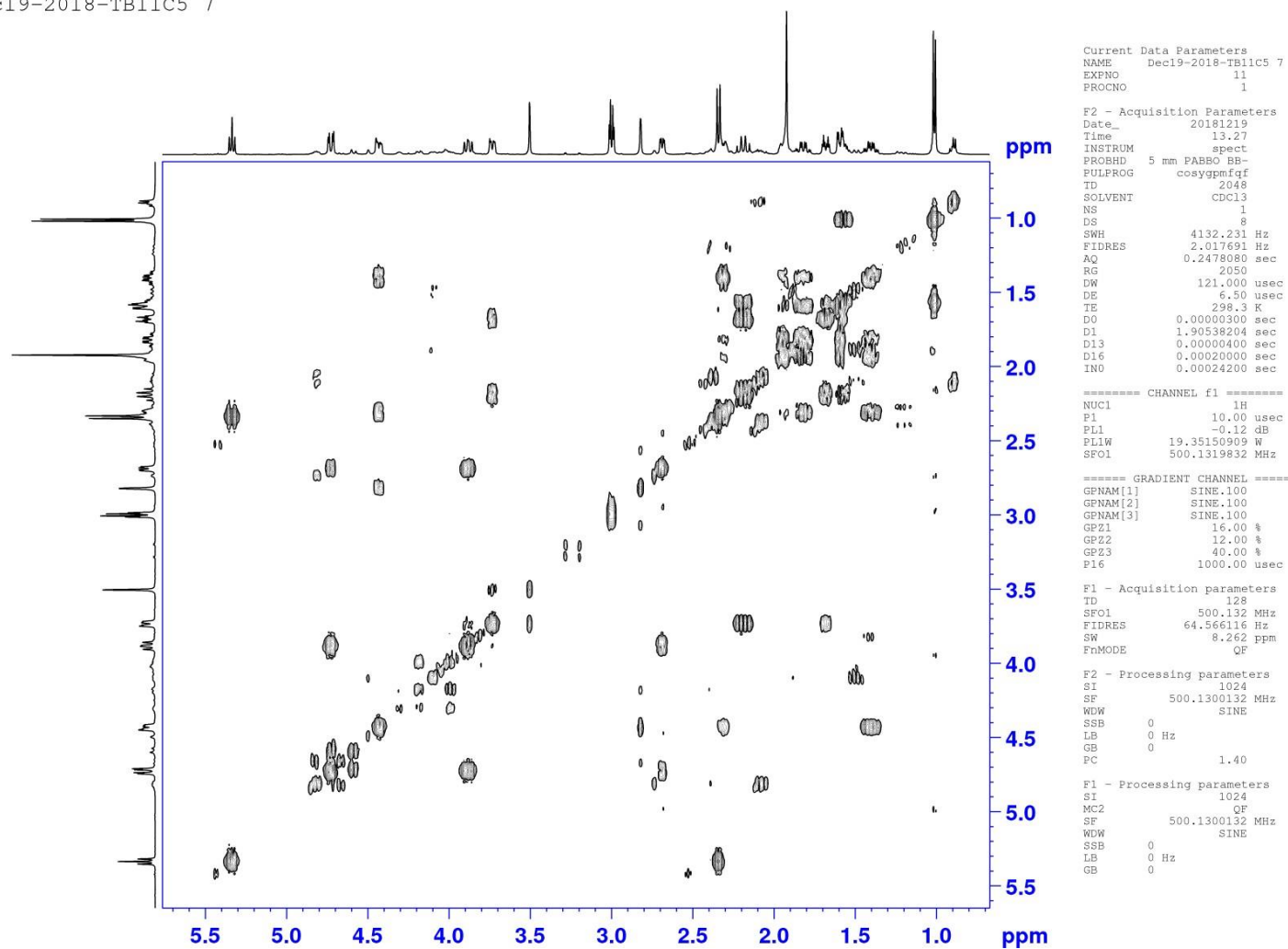
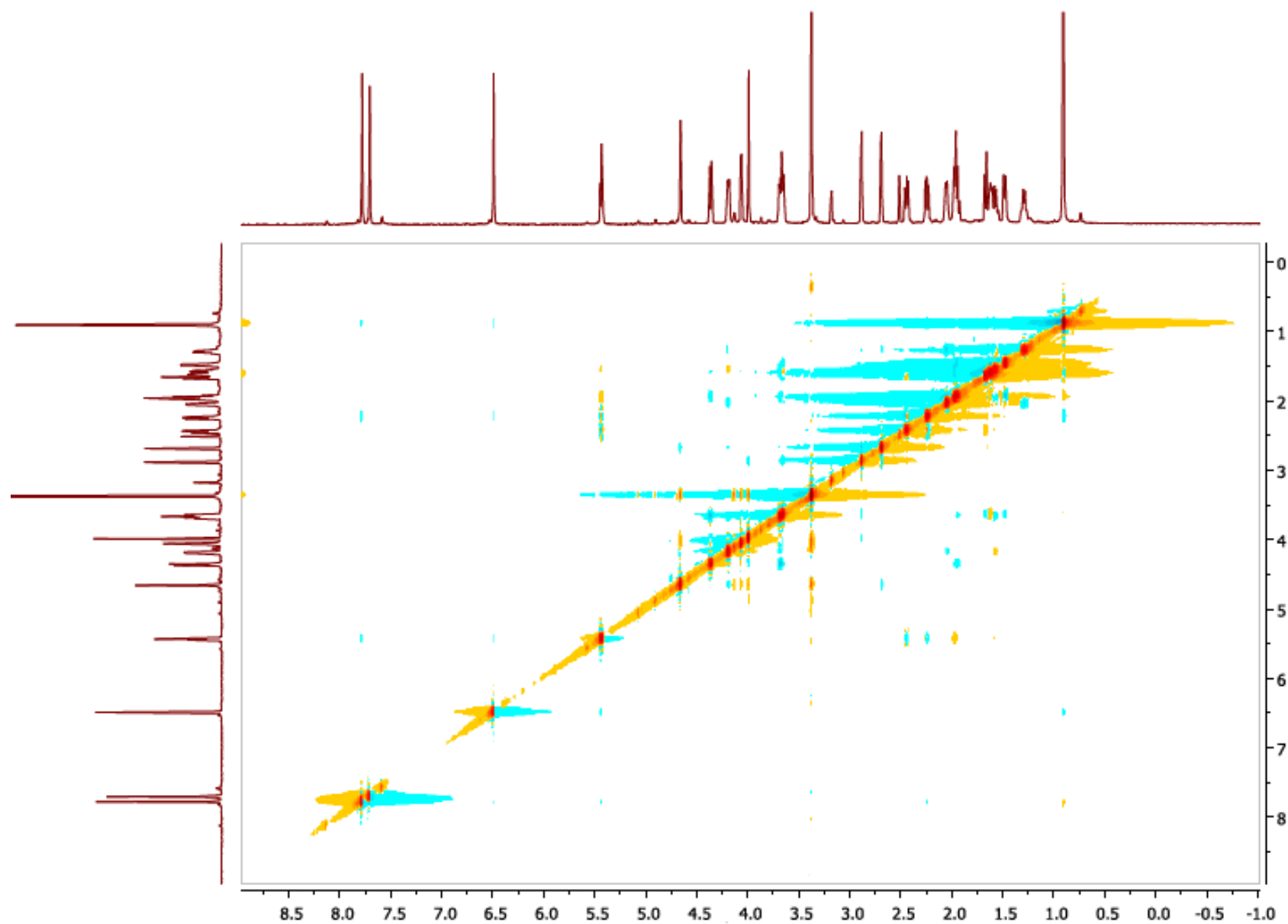


Figure S137. COSY NMR spectrum of **15** in CDCl<sub>3</sub>.

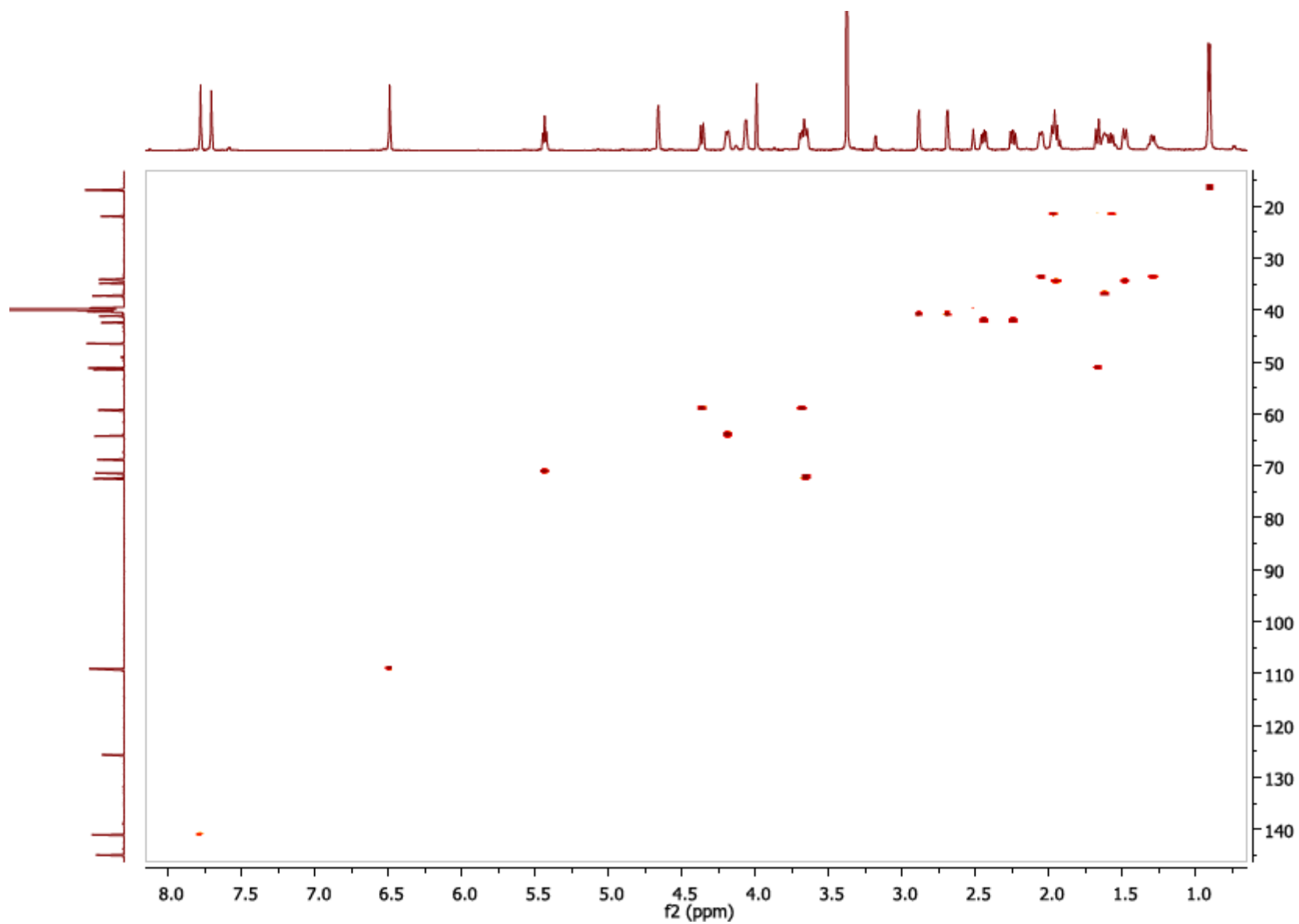
Dec19-2018-TB11C5 7



**Figure S138.** Expansion of part of COSY NMR spectrum of **15** in CDCl<sub>3</sub>.

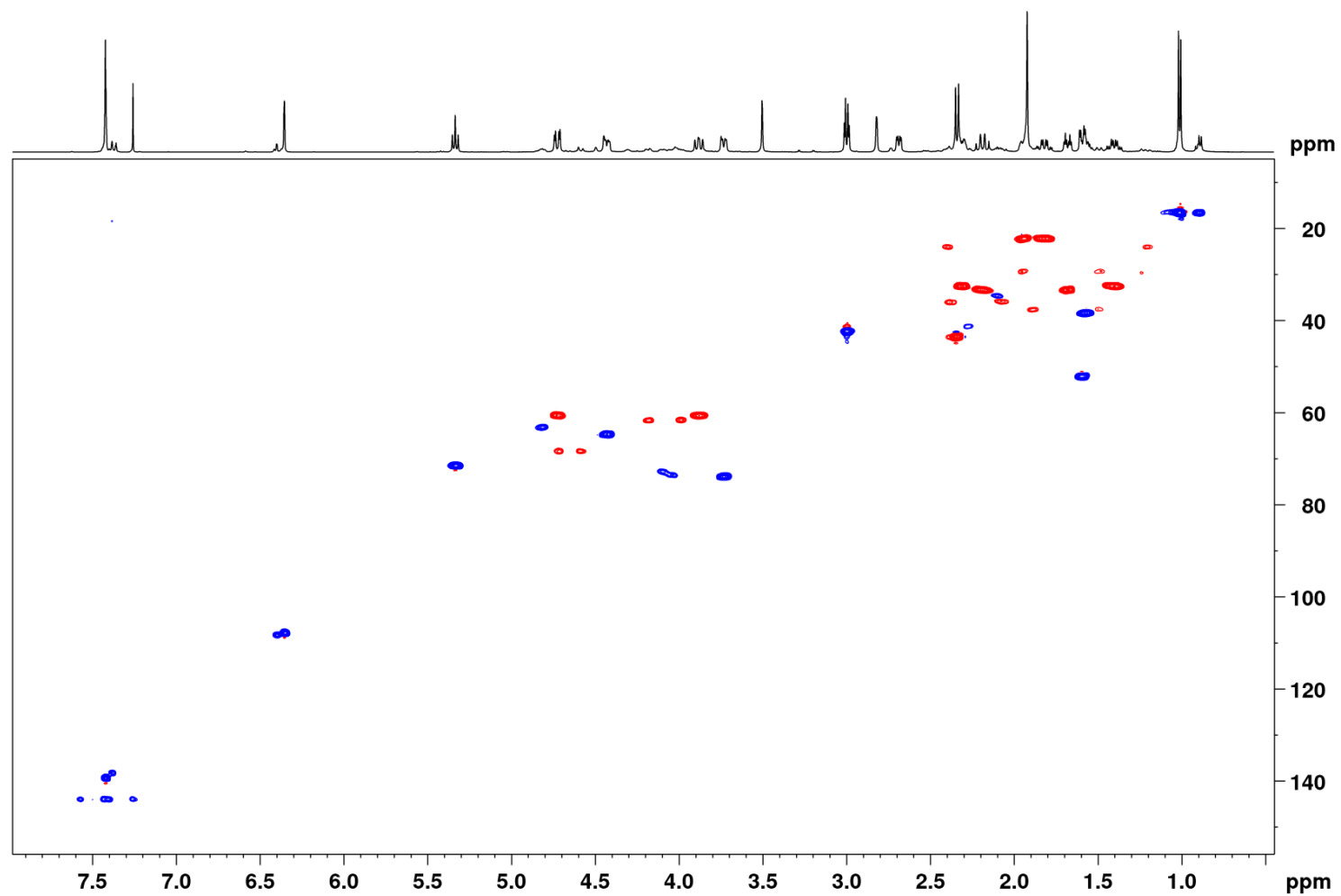


**Figure S139.** NOESY NMR spectrum of **15** in  $(\text{CD}_3)_2\text{SO}$ .

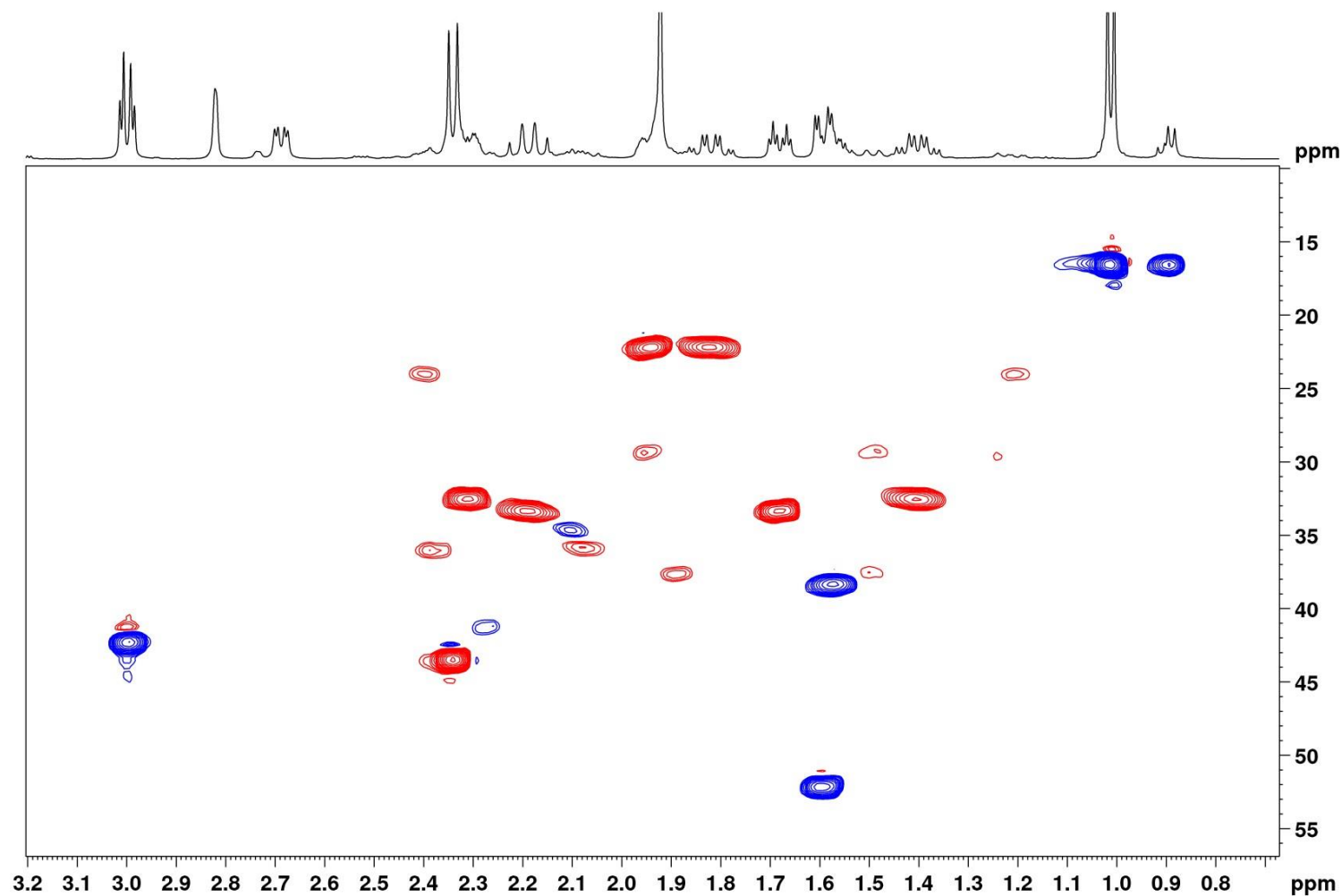


**Figure S140.** HSQC NMR spectrum of **15** in  $(\text{CD}_3)_2\text{SO}$ .

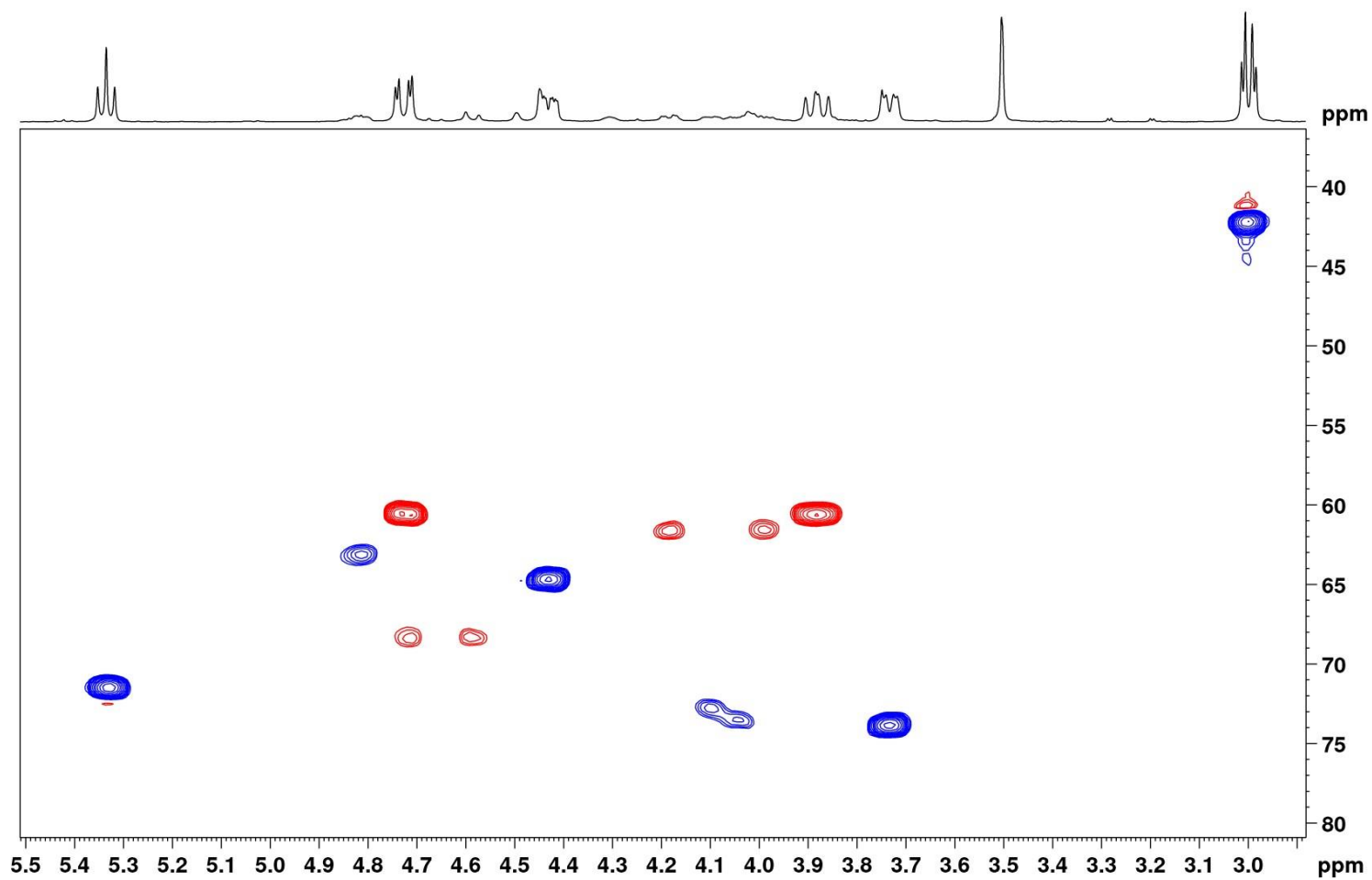
Dec19-2018-TB11C5 7



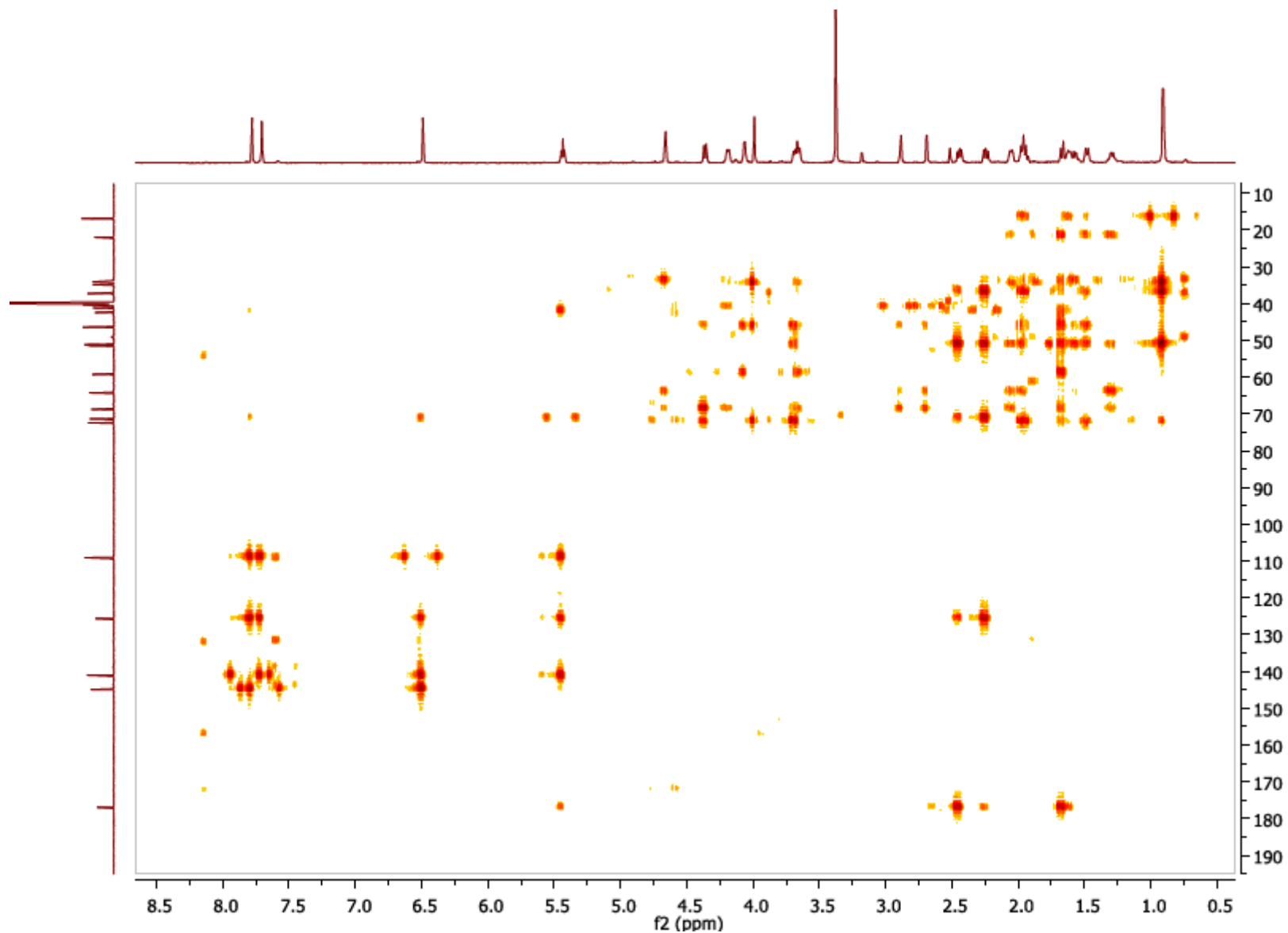
**Figure S141.** HSQC NMR spectrum of **15** in  $\text{CDCl}_3$ .



**Figure S142.** Expansion of part of HSQC NMR spectrum ( $\delta$  0.7 –  $\delta$  3.2) of **15** in  $\text{CDCl}_3$ .



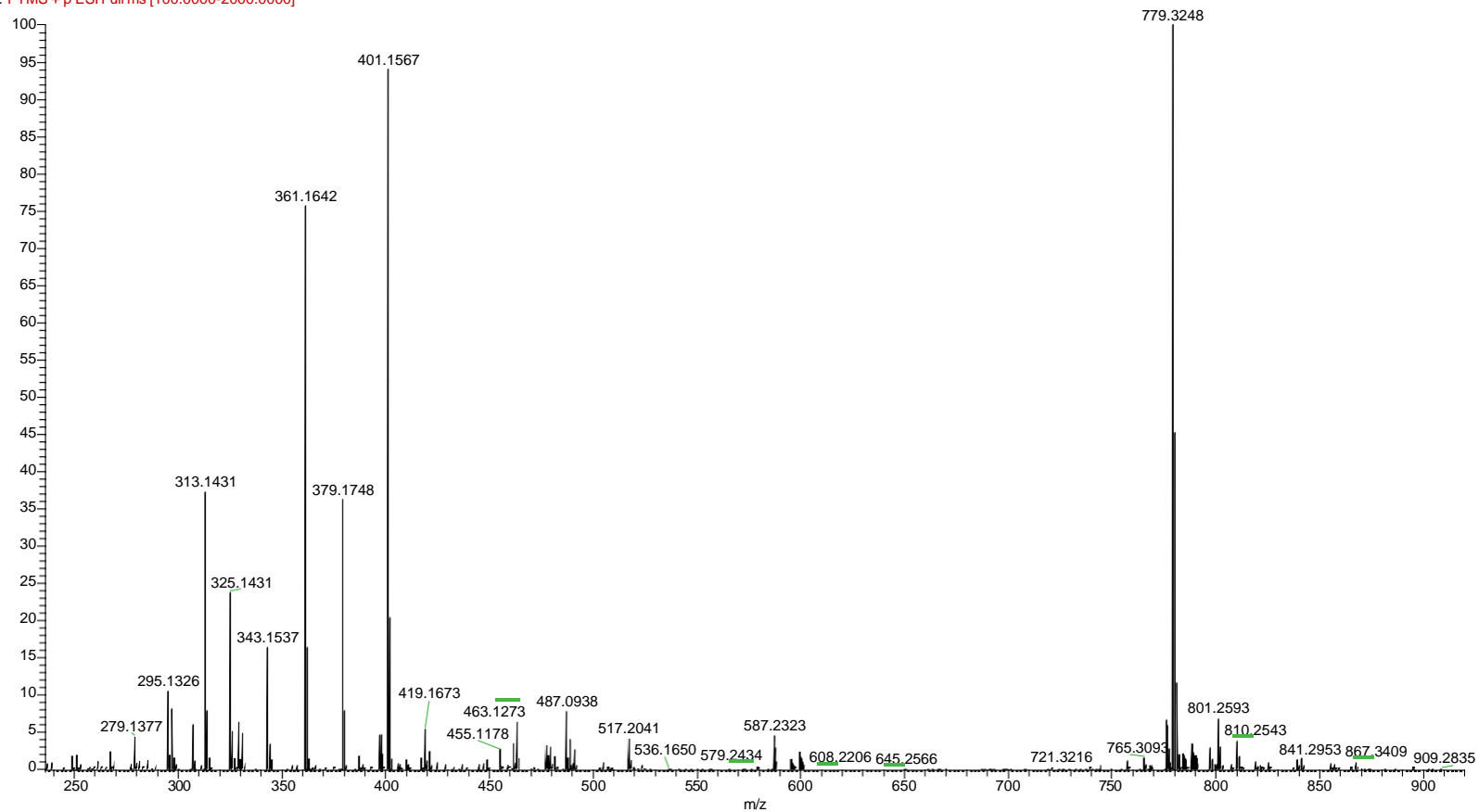
**Figure S143.** Expansion of part of HSQC NMR spectrum ( $\delta$  2.9 –  $\delta$  5.5) of **15** in CDCl<sub>3</sub>.



**Figure S144.** HMBC NMR spectrum of **15** in  $(\text{CD}_3)_2\text{SO}$ .

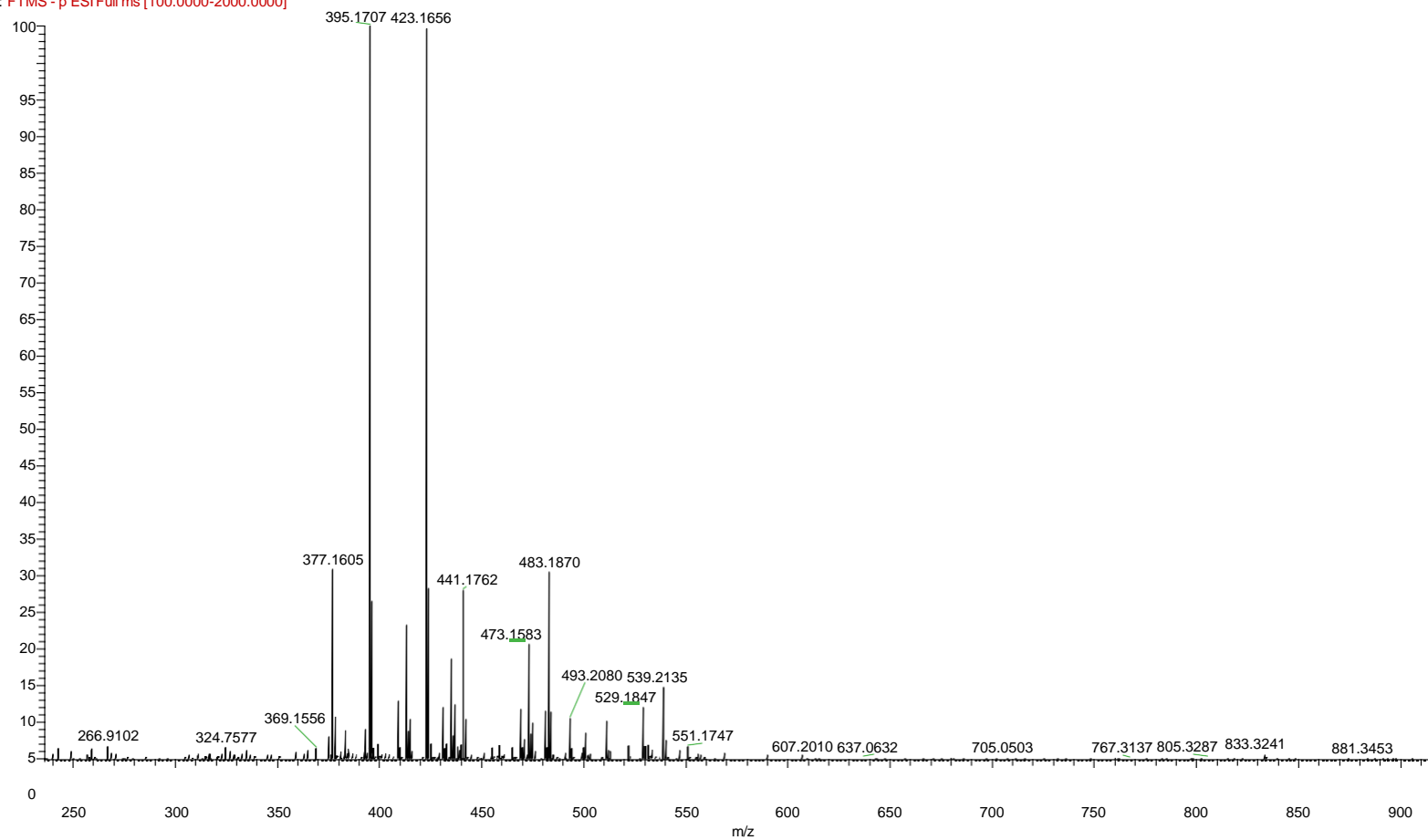


R6 #265-290 RT: 3.79-4.13 AV: 13 NL: 1.99E7  
F: FTMS + p ESI Full ms [100.0000-2000.0000]

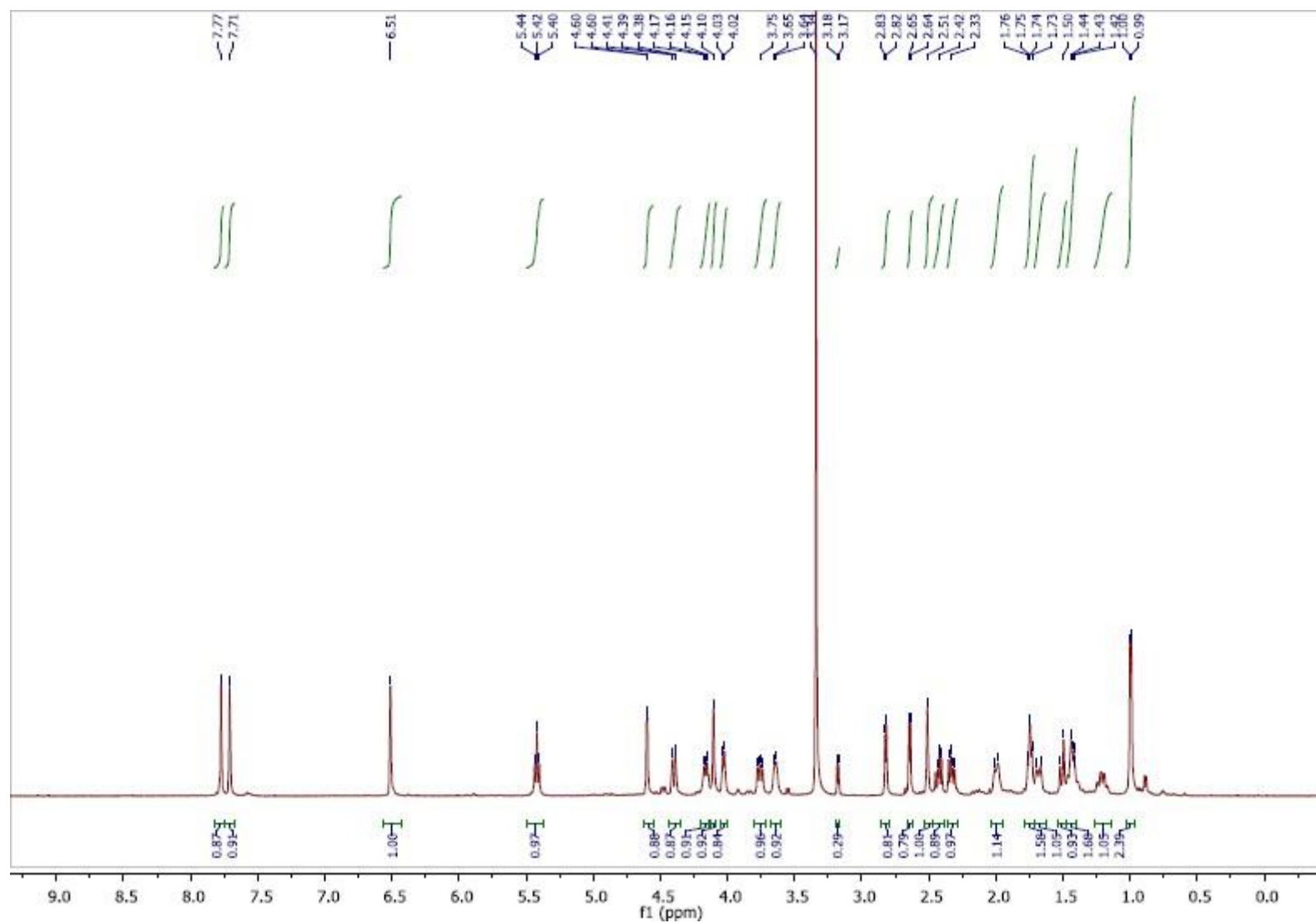


**Figure S145.** Positive-ion HRESIMS of **15**.

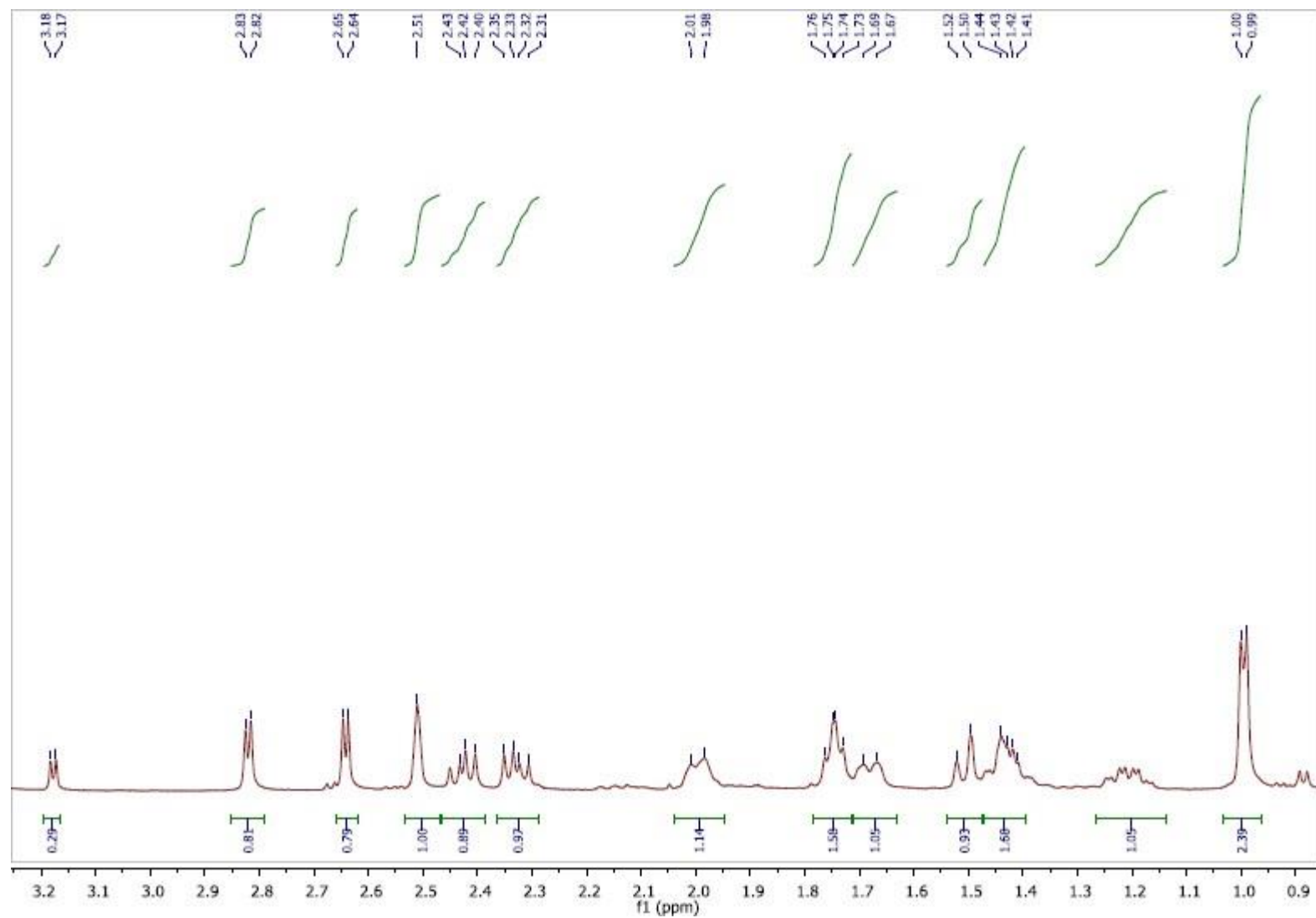
R6 #265-290 RT: 3.80-4.14 AV: 13 NL: 1.49E6  
F: FTMS - p ESI Full ms [100.0000-2000.0000]



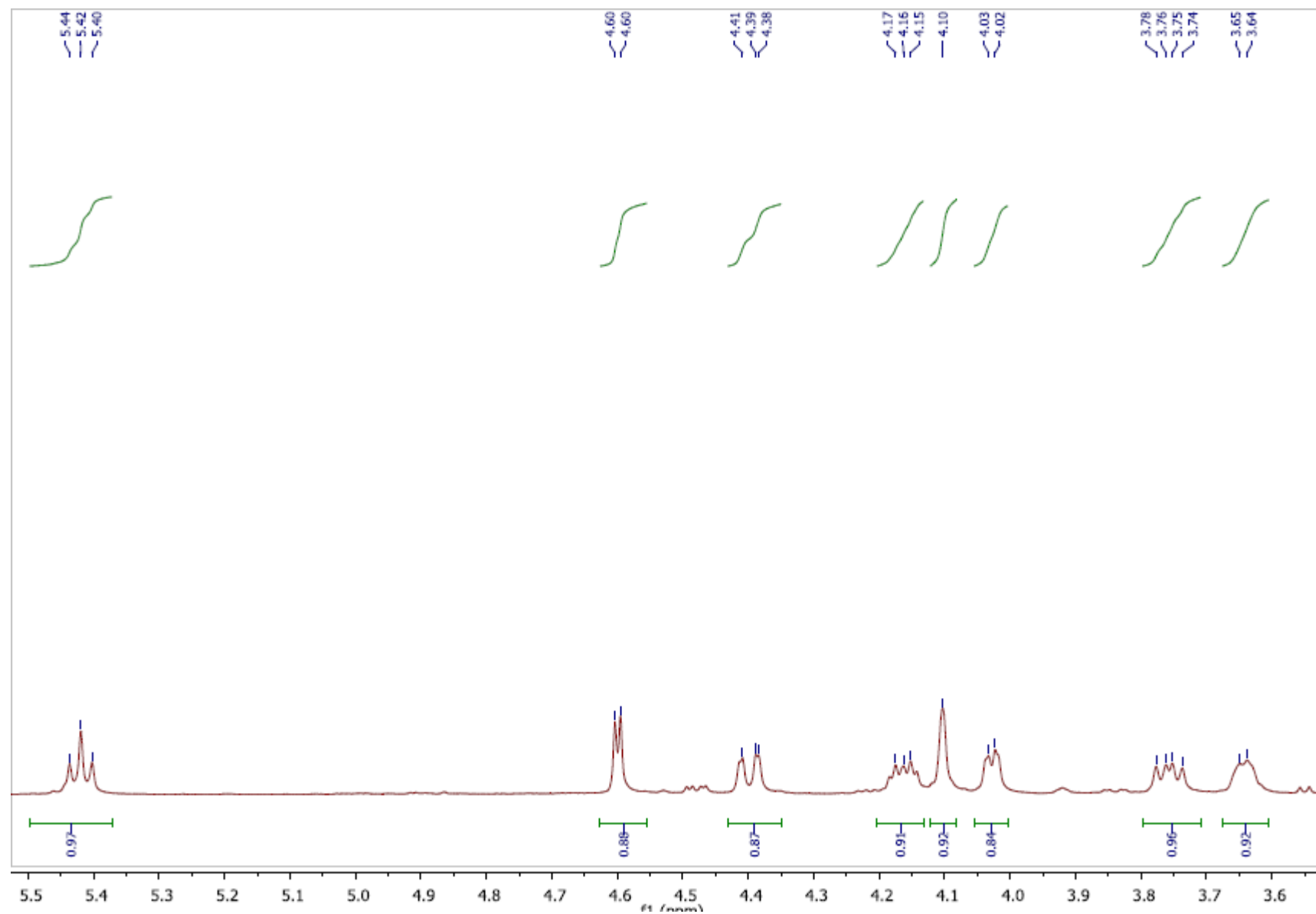
**Figure S146.** Negative-ion HRESIMS of **15**.



**Figure S147.** <sup>1</sup>H NMR spectrum of **16** in (CD<sub>3</sub>)<sub>2</sub>SO.



**Figure S148.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.9 –  $\delta$  3.2) of **16** in  $(\text{CD}_3)_2\text{SO}$ .



**Figure S149.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  3.6 –  $\delta$  5.5) of **16** in  $(\text{CD}_3)_2\text{SO}$ .

Dec19-2018-TB11C4 6

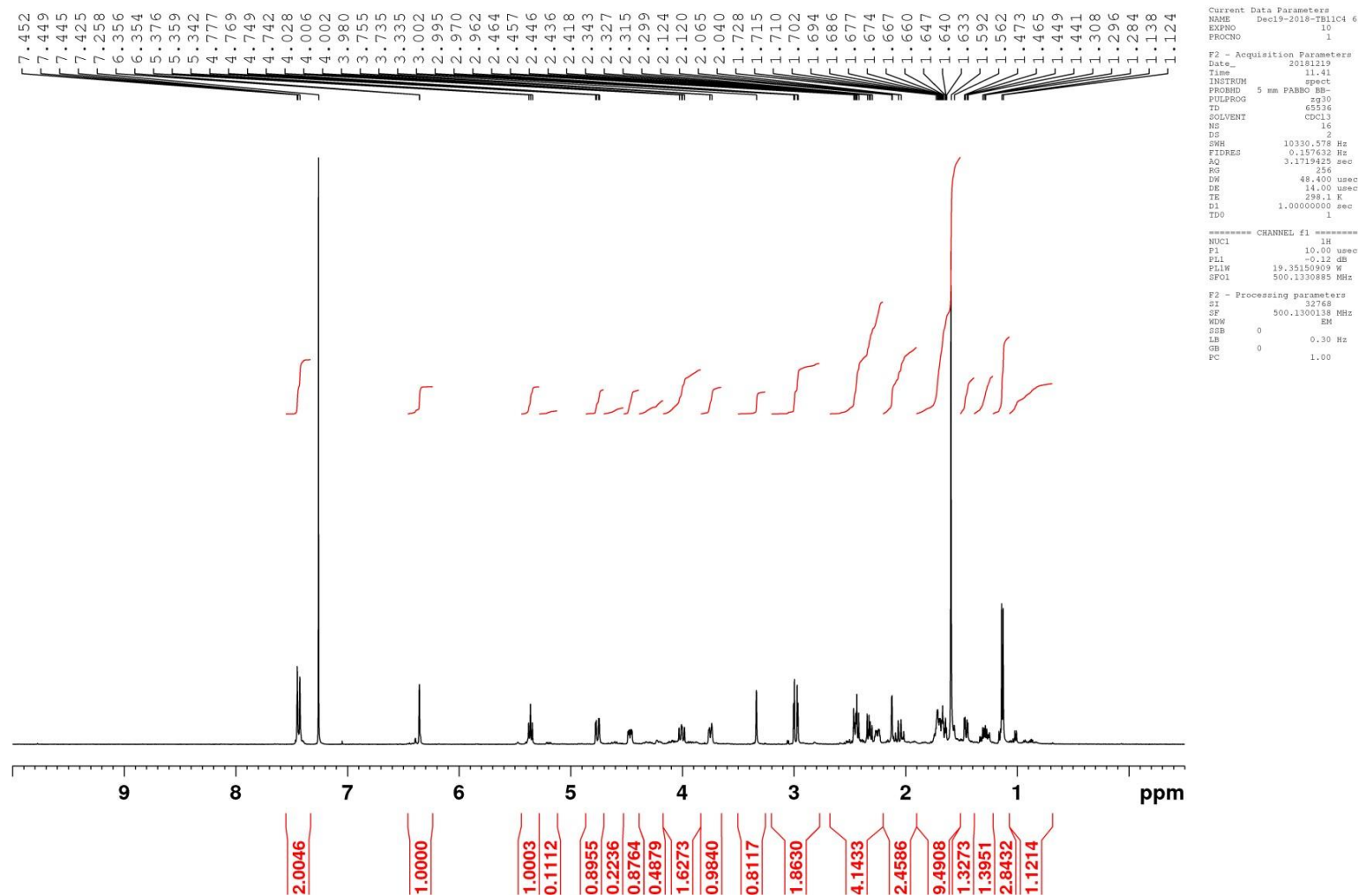
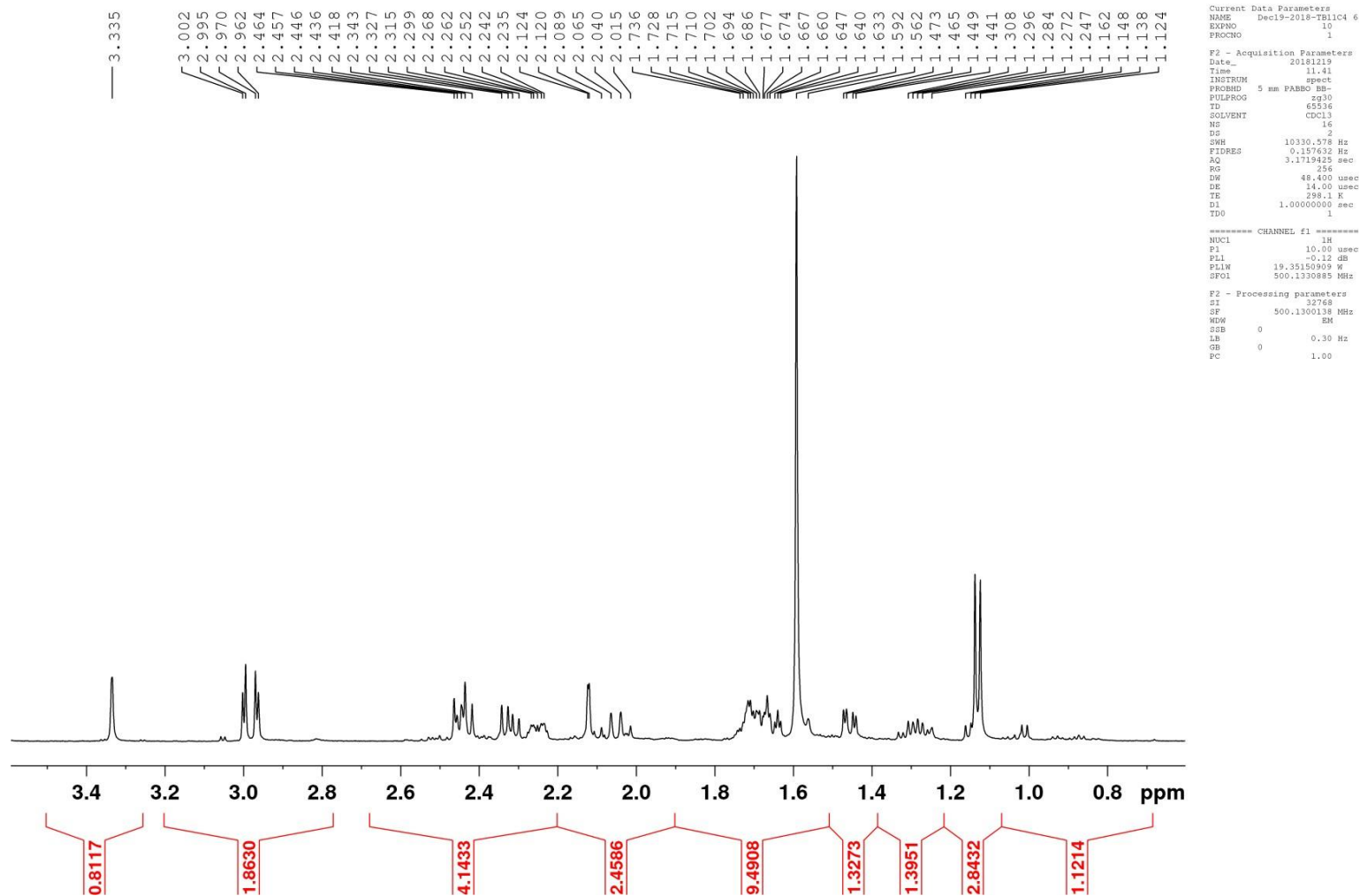


Figure S150.  $^1\text{H}$  NMR spectrum of **16** in  $\text{CDCl}_3$ .

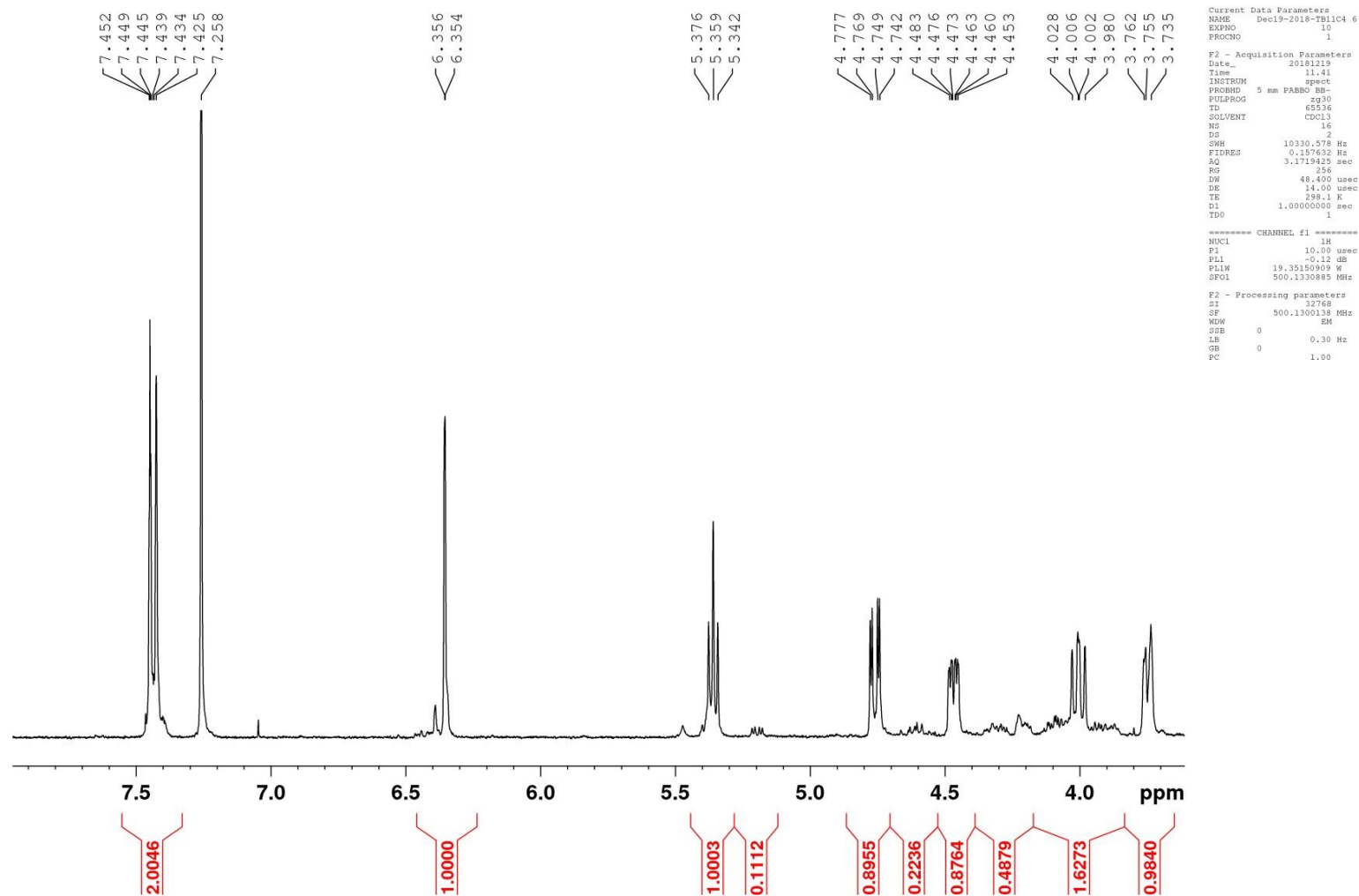


Dec19-2018-TB11C4 6

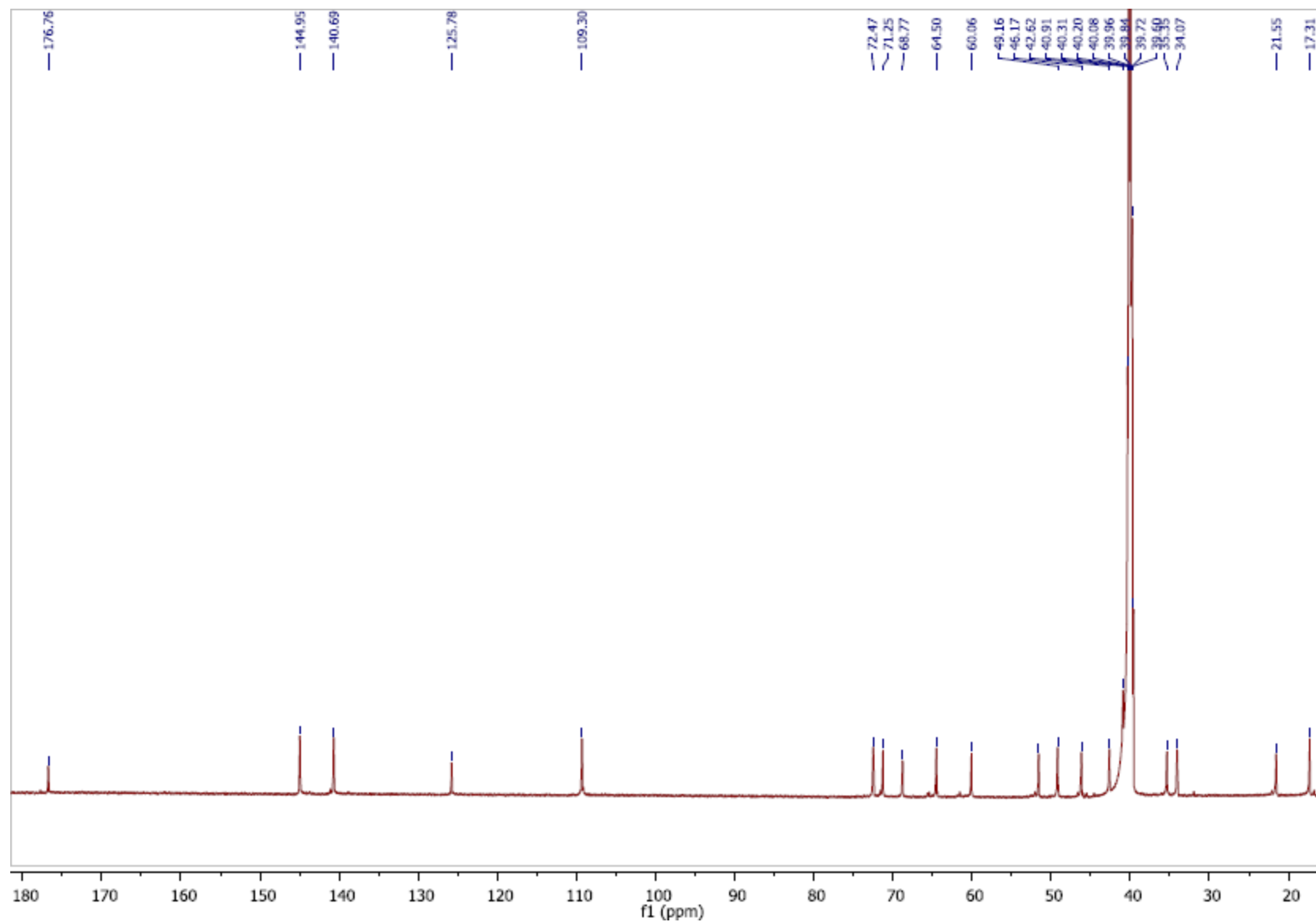


**Figure S151.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.7 –  $\delta$  3.5) of **16** in  $\text{CDCl}_3$ .

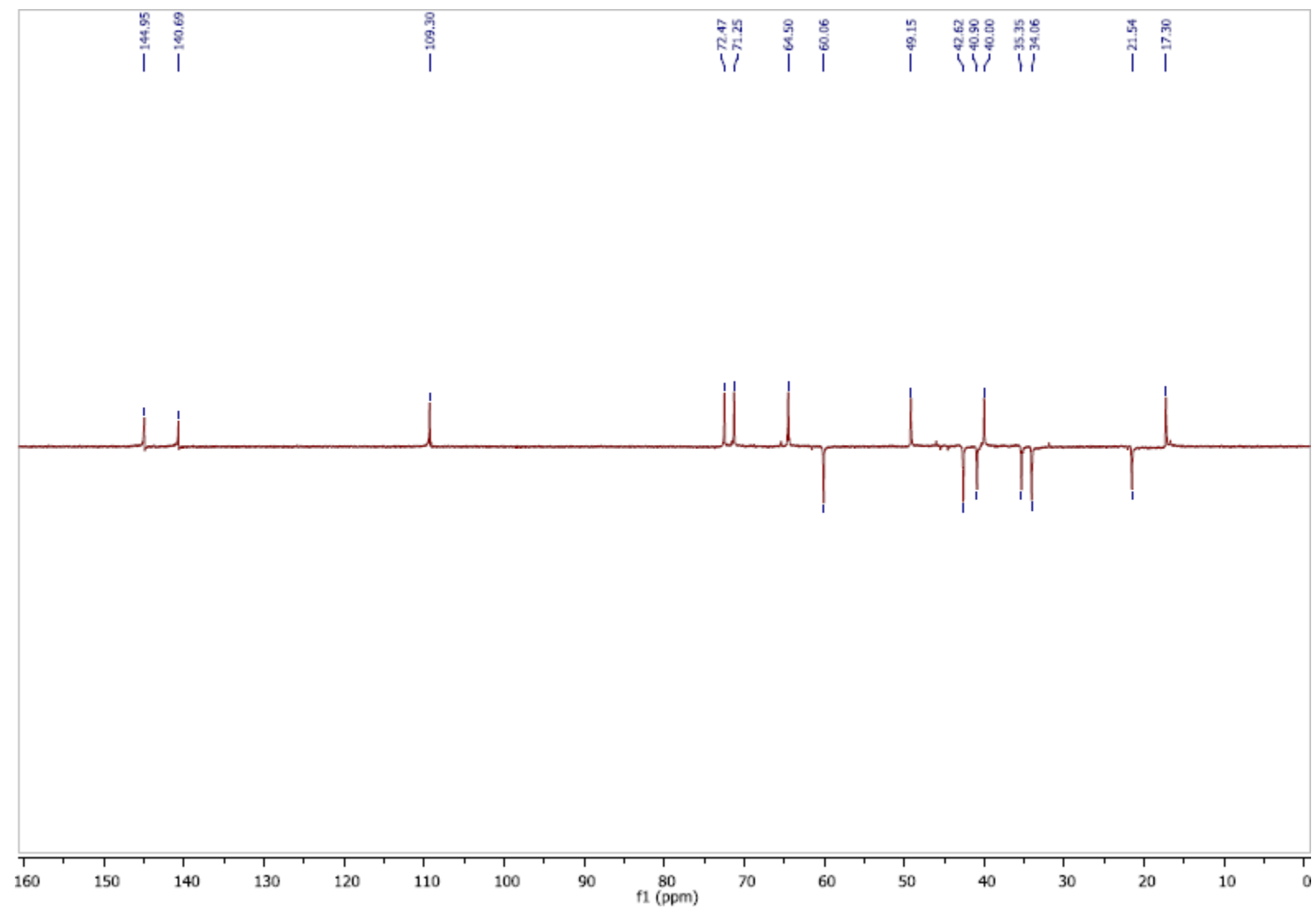
Dec19-2018-TB11C4 6



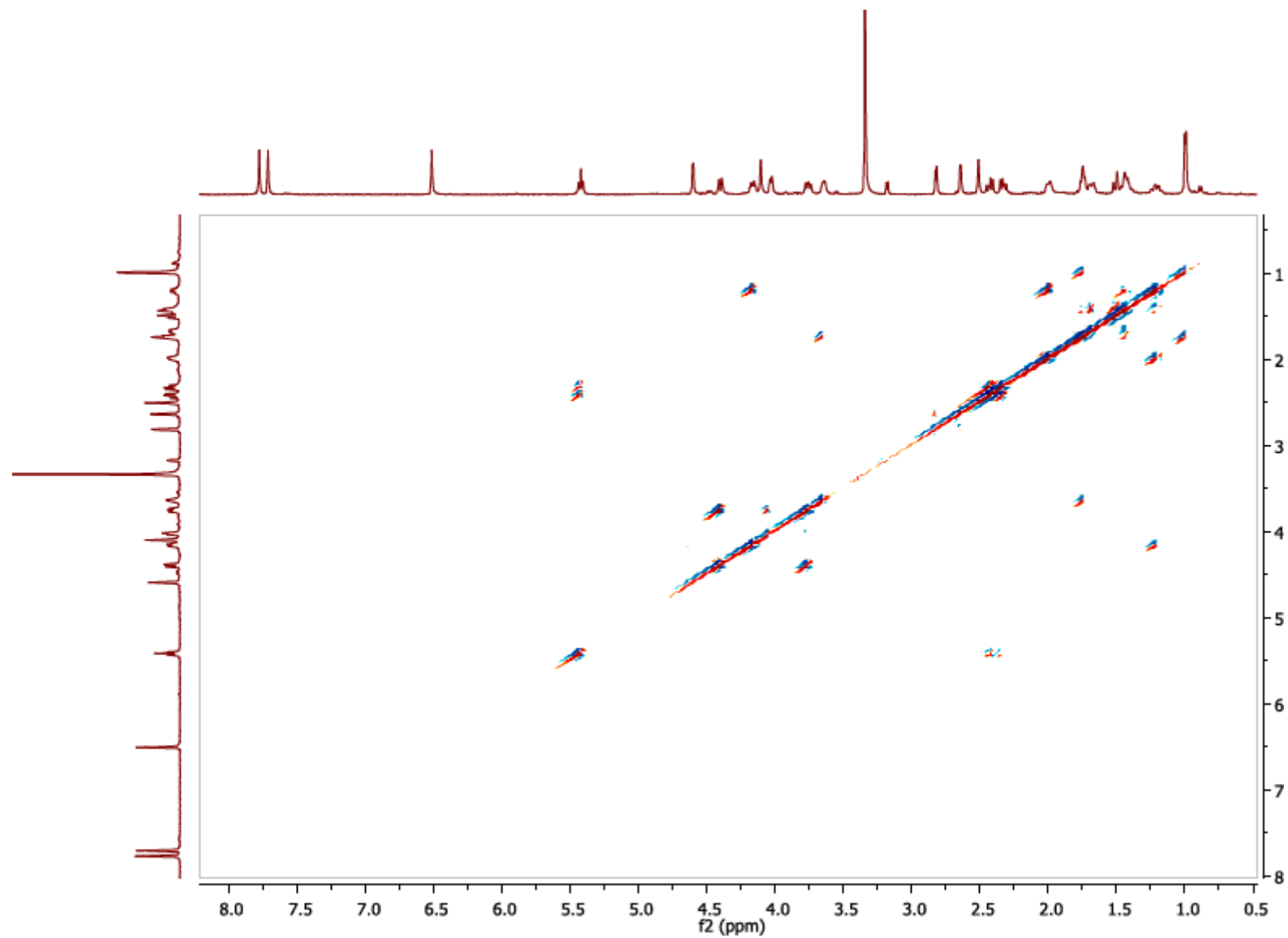
**Figure S157.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  3.7 –  $\delta$  7.9) of **16** in  $\text{CDCl}_3$ .



**Figure S153.** <sup>13</sup>C NMR spectrum of **16** in (CD<sub>3</sub>)<sub>2</sub>SO.

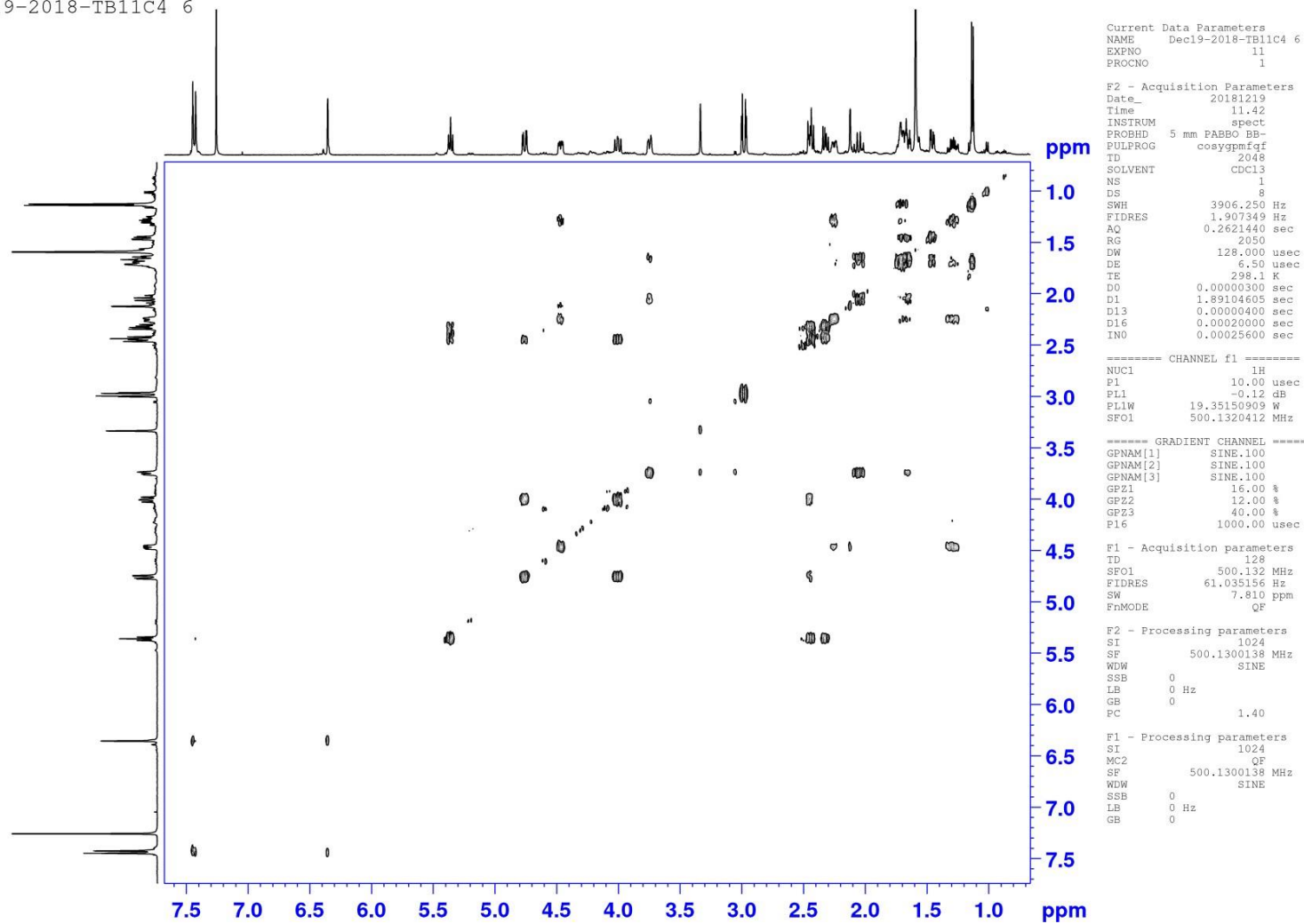


**Figure S154.**  $^{13}\text{C}$ DEPT NMR spectrum of **16** in  $(\text{CD}_3)_2\text{SO}$ .

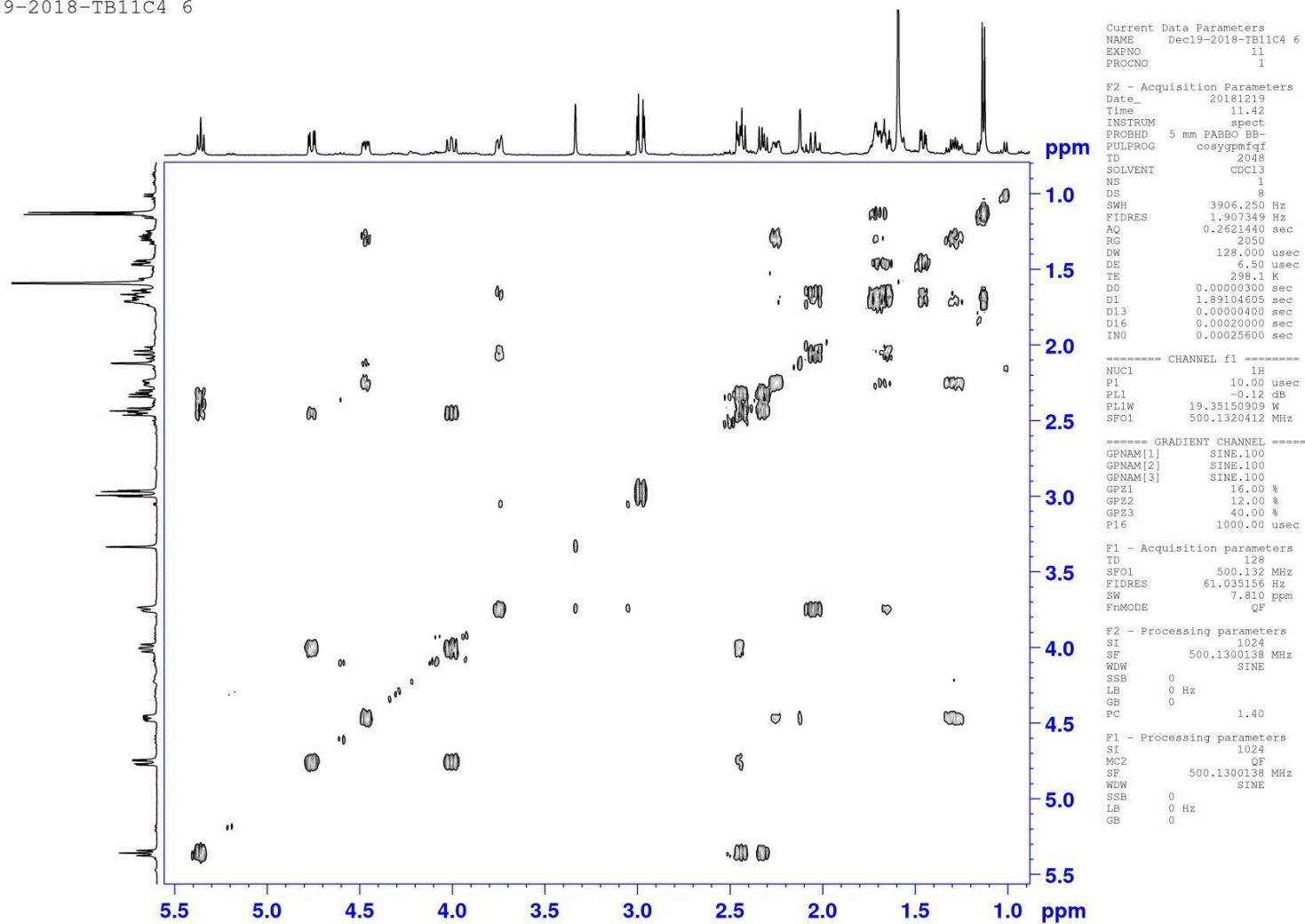


**Figure S155.** COSY NMR spectrum of **16** in (CD<sub>3</sub>)<sub>2</sub>SO.

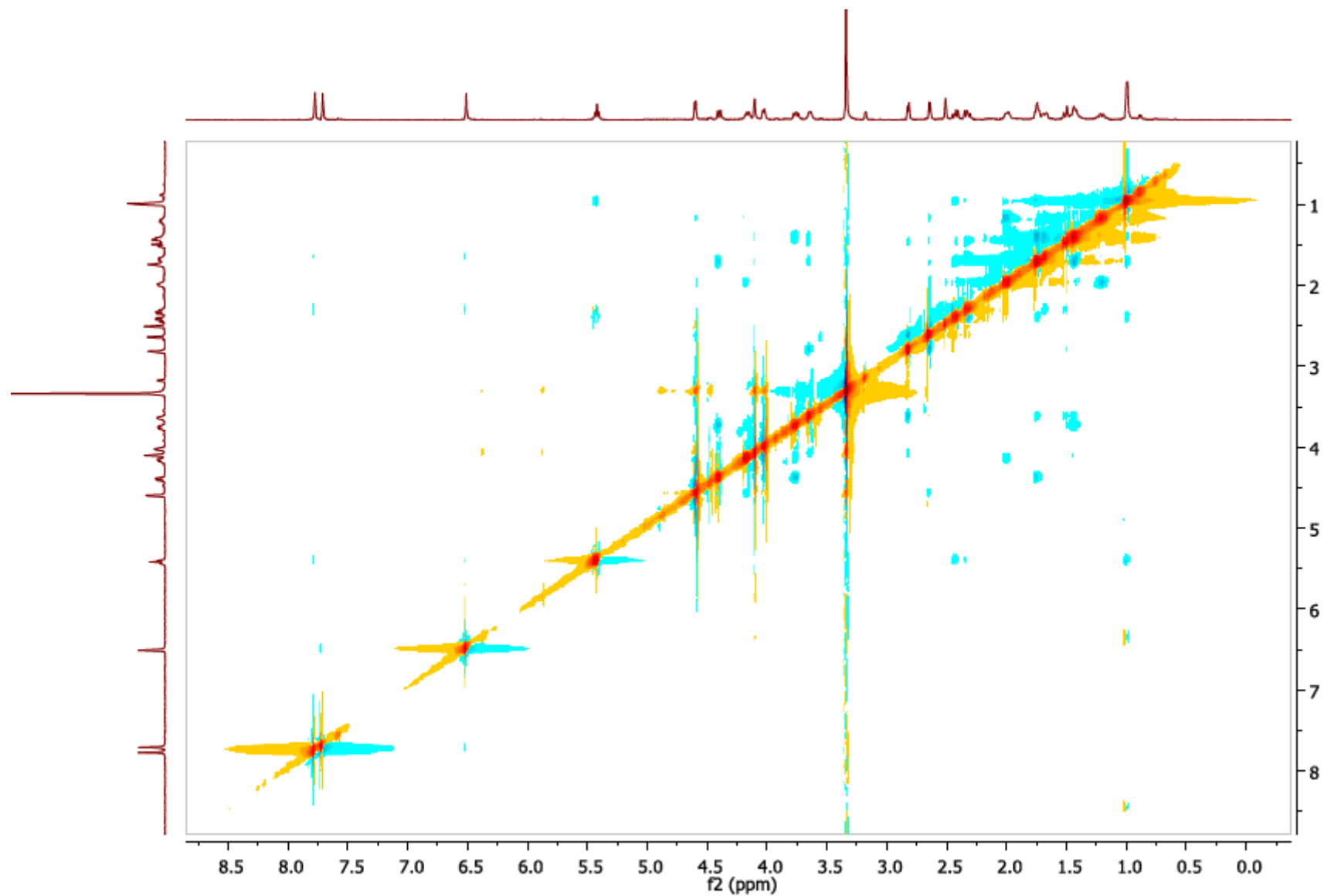
Dec19-2018-TB11C4 6



**Figure S156.** COSY NMR spectrum of **16** in CDCl<sub>3</sub>.

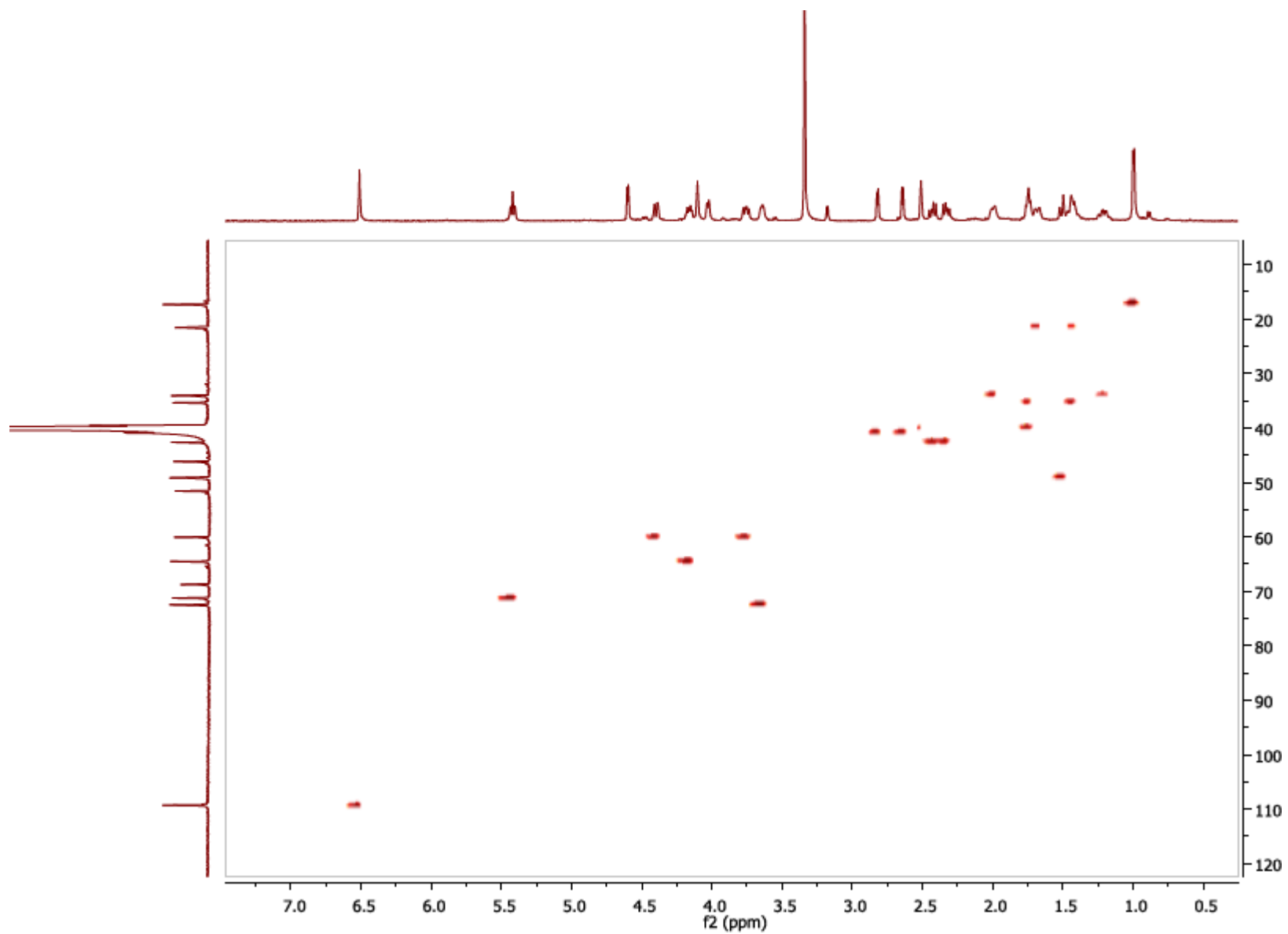


**Figure S157.** Expansion of part of COSY NMR spectrum ( $\delta$  0.9 –  $\delta$  5.5) of **16** in  $\text{CDCl}_3$ .



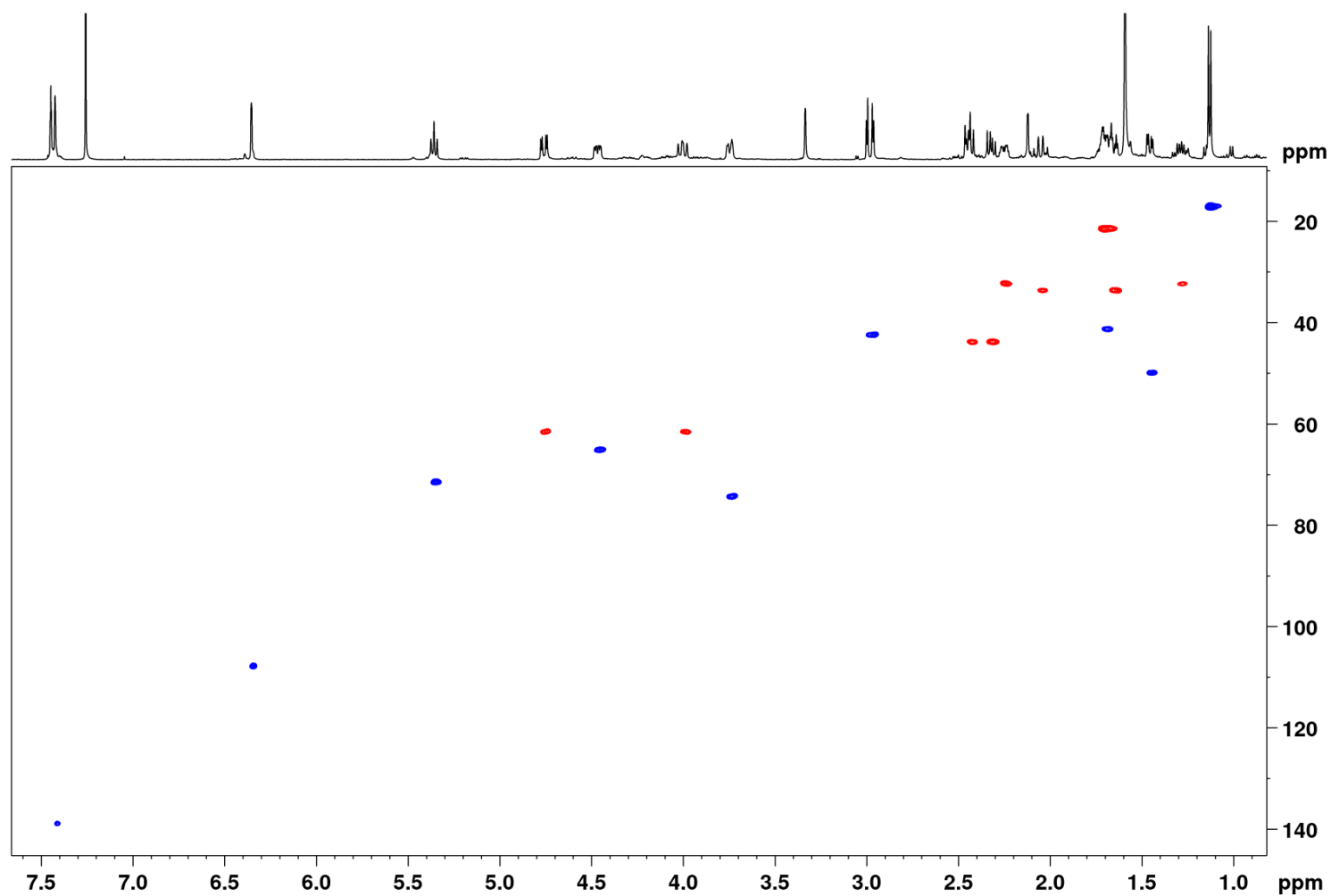
**Figure S158.** NOESY NMR spectrum of **16** in  $(\text{CD}_3)_2\text{SO}$ .



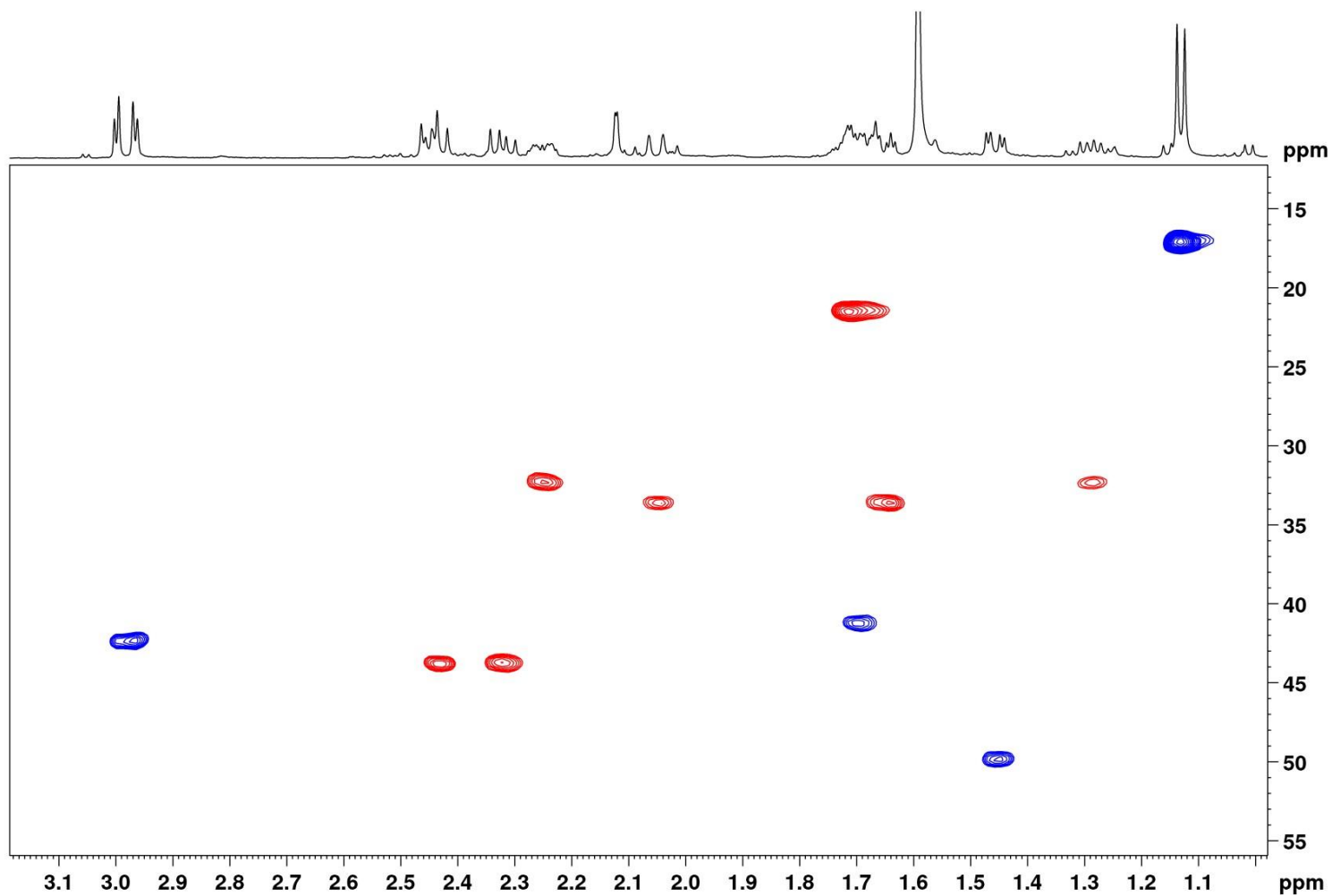


**Figure S159.** HSQC NMR spectrum of **16** in  $(\text{CD}_3)_2\text{SO}$ .

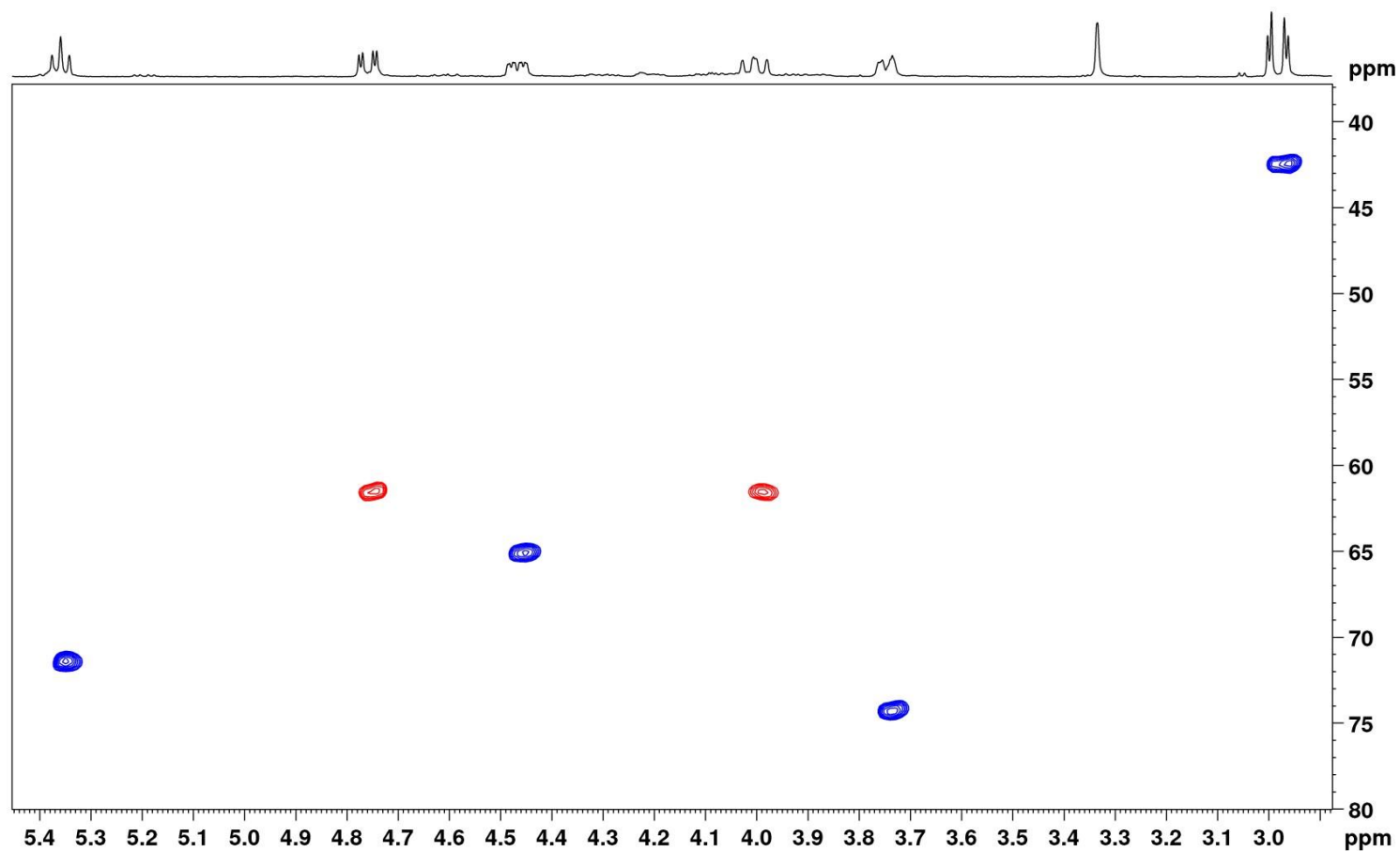
Dec19-2018-TB11C4 6



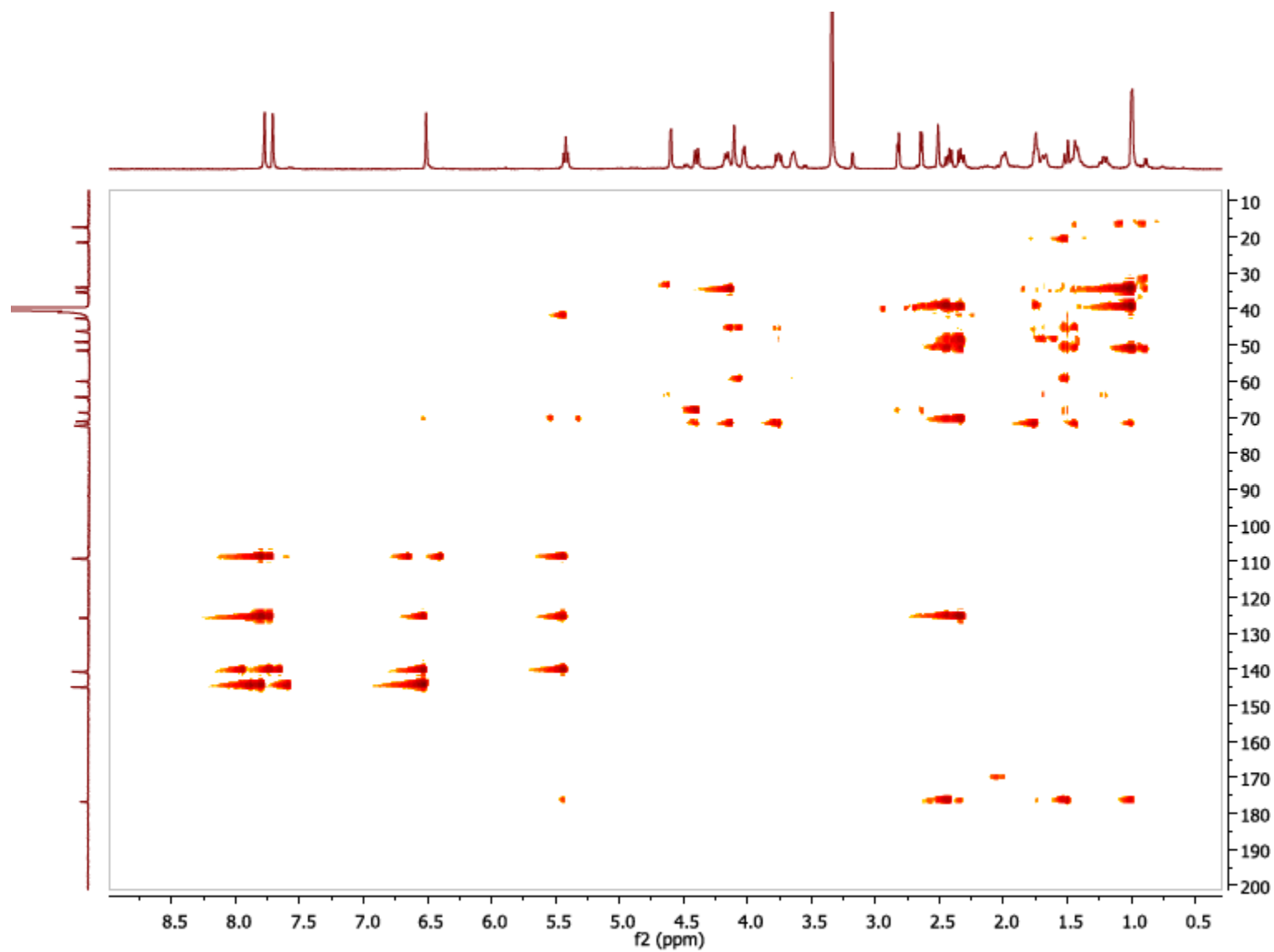
**Figure S160.** HSQC NMR spectrum of **16** in  $\text{CDCl}_3$ .



**Figure S161.** Expansion of part of HSQC NMR spectrum ( $\delta$  1.0 –  $\delta$  3.1) of **16** in  $\text{CDCl}_3$ .

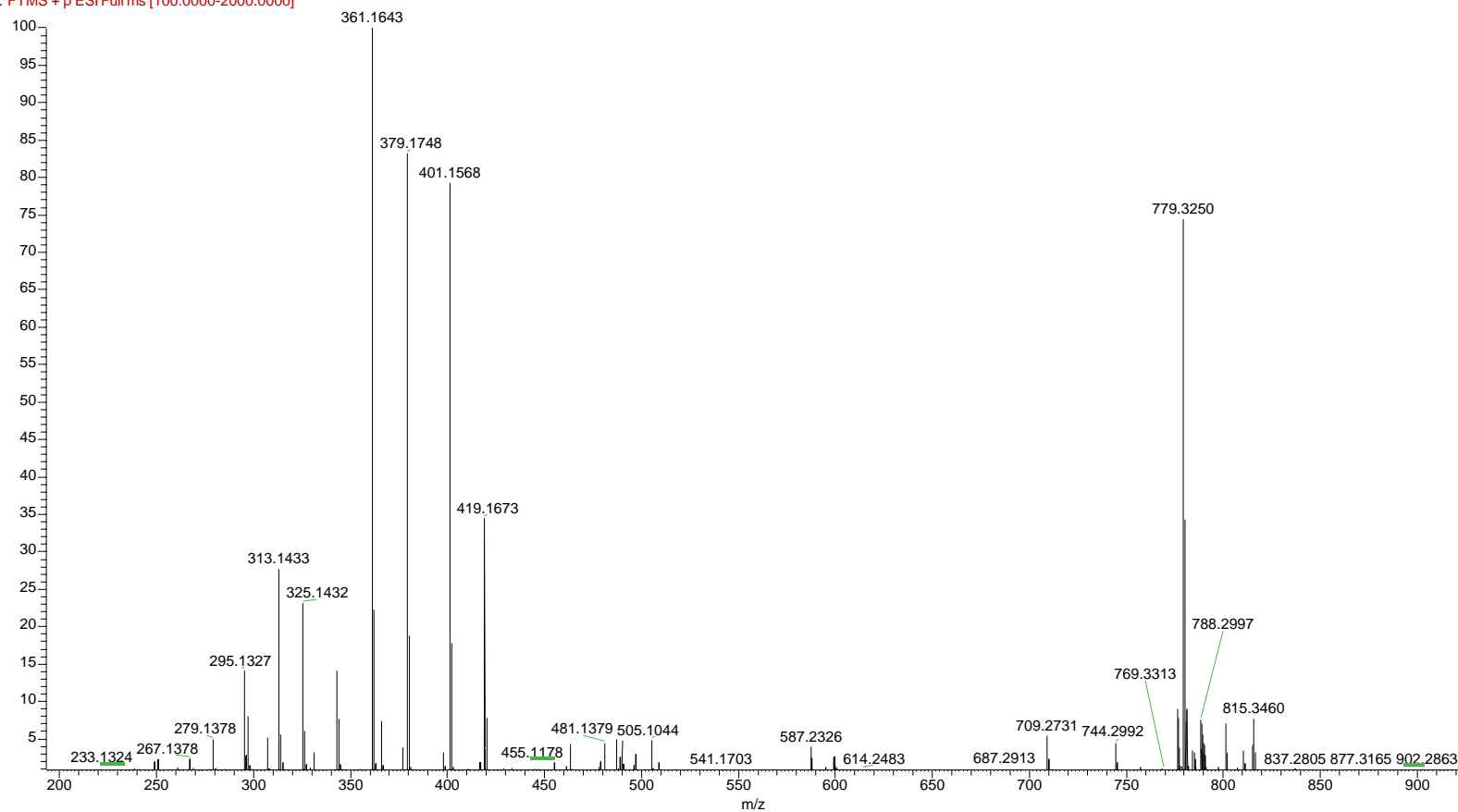


**Figure S162.** Expansion of part of HSQC NMR spectrum ( $\delta$  2.9 –  $\delta$  5.4) of **16** in  $\text{CDCl}_3$ .



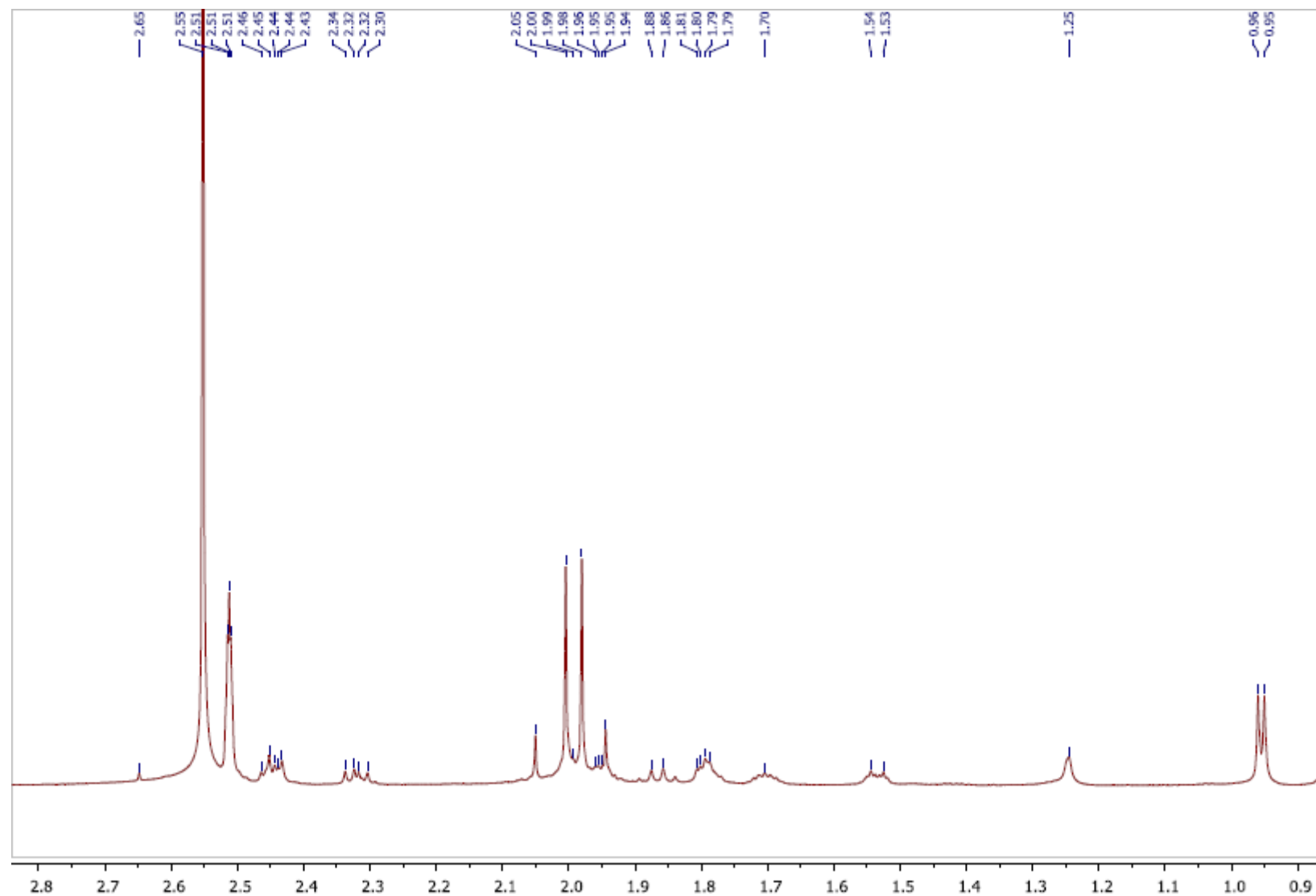
**Figure S163.** HMBC NMR spectrum of **16** in  $(\text{CD}_3)_2\text{SO}$ .

R7 #235-299 RT: 3.36-4.25 AV: 33 NL: 1.18E7  
F: FTMS + p ESI Full ms [100.0000-2000.0000]



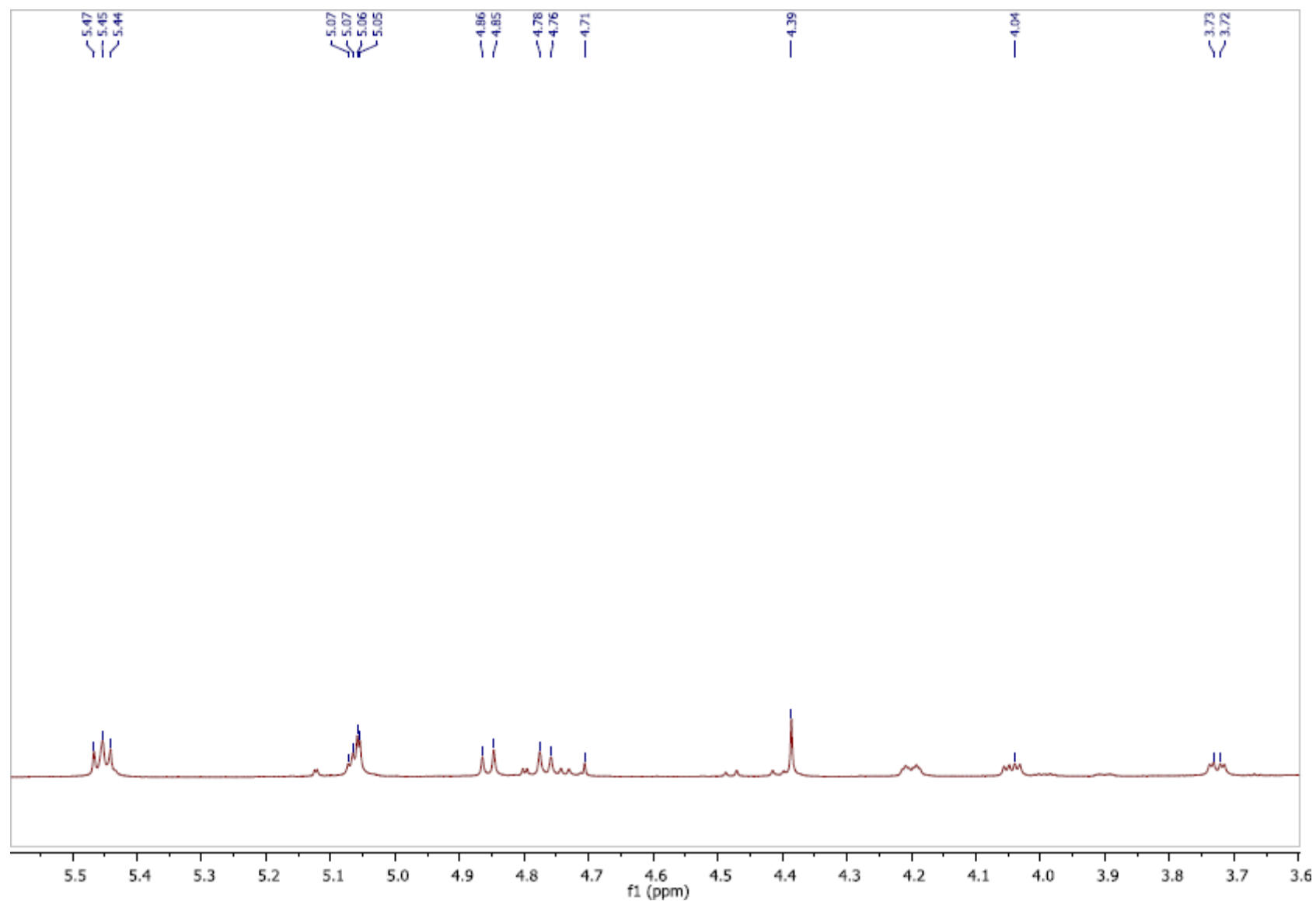
**Figure S164.** Positive-ion HRESIMS of **16**.





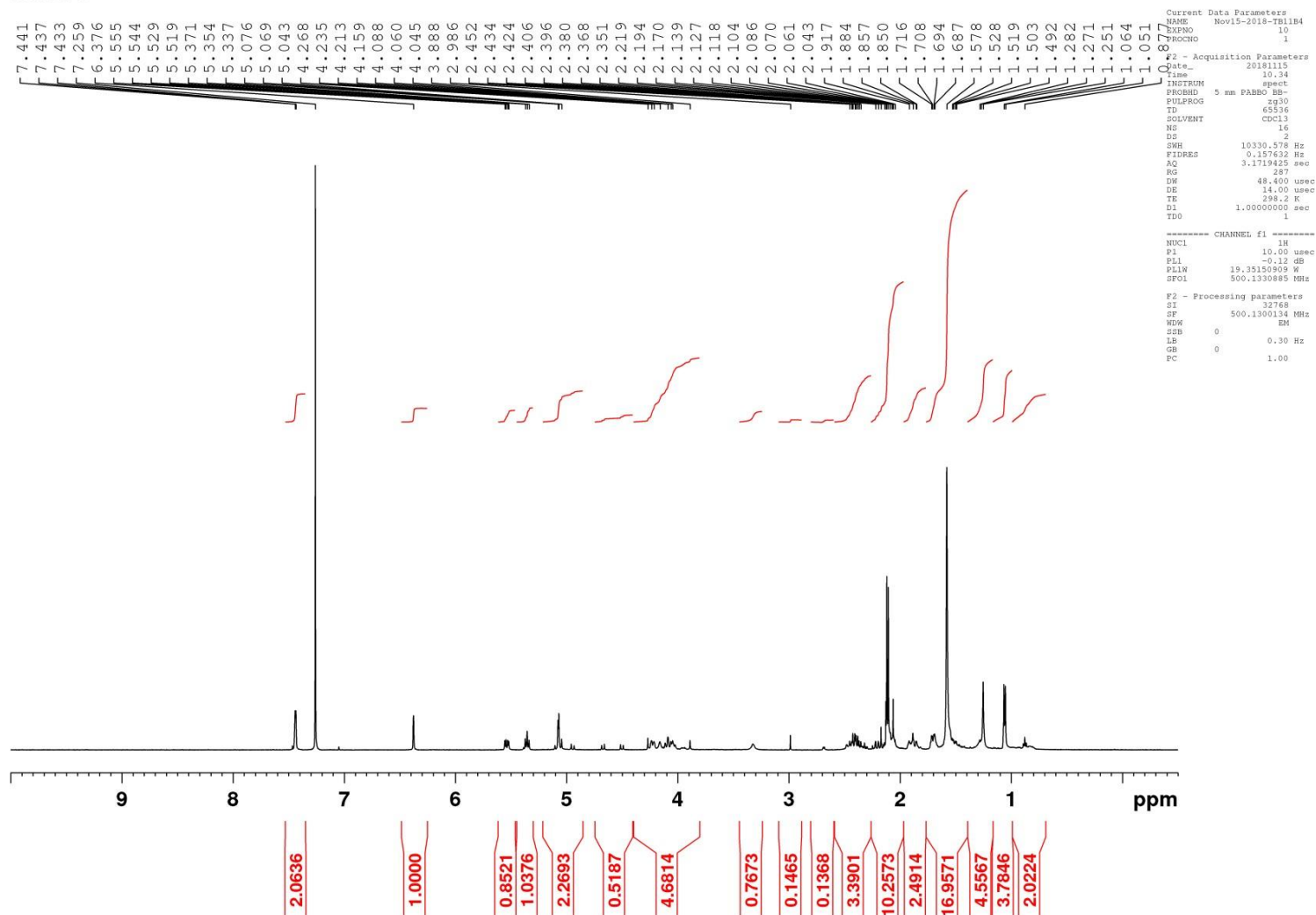
**Figure S166.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.9 –  $\delta$  2.8) of **17** in  $(\text{CD}_3)_2\text{SO}$ .





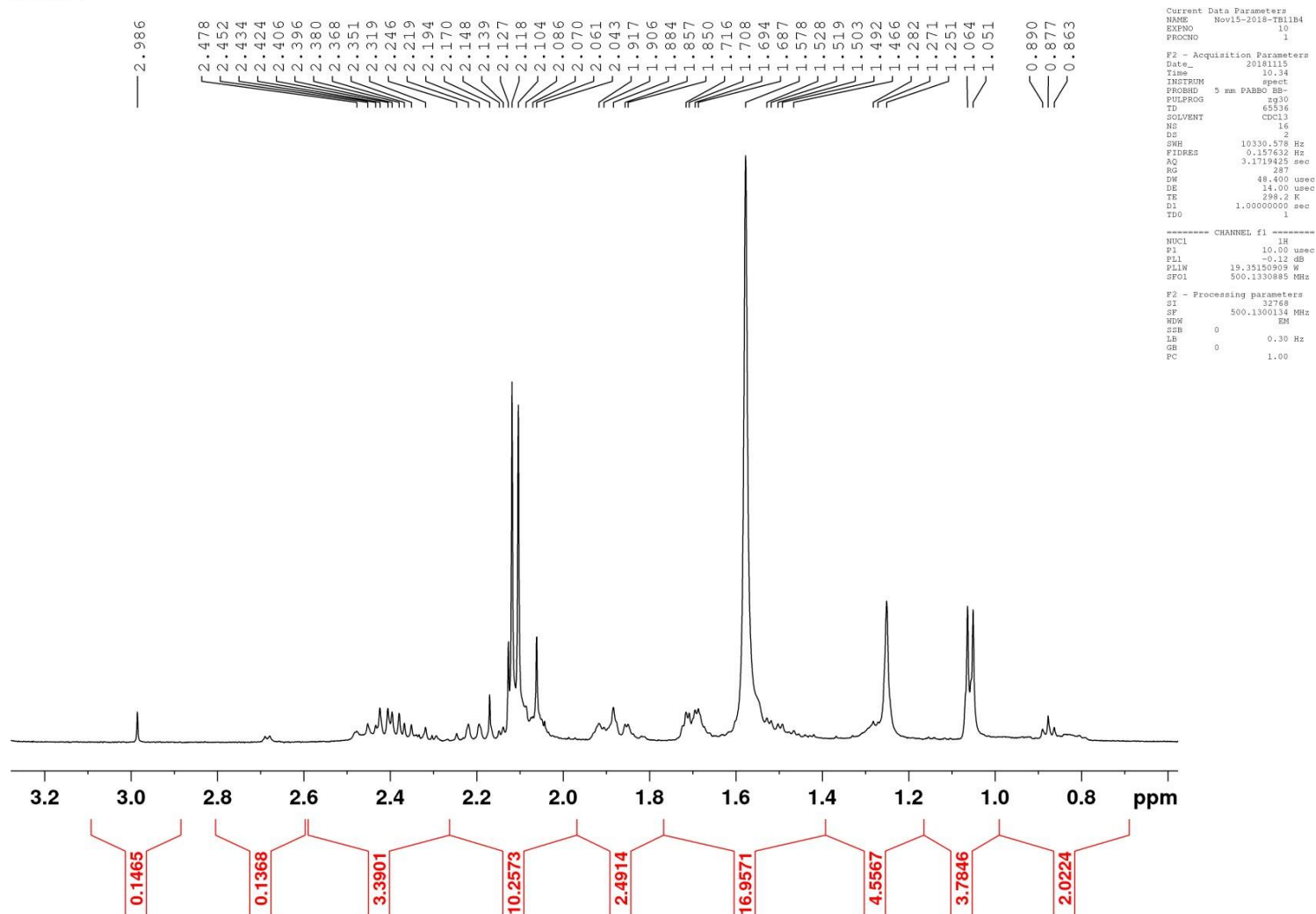
**Figure S167.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  3.6 –  $\delta$  5.5) of **17** in  $(\text{CD}_3)_2\text{SO}$ .

TB11B4



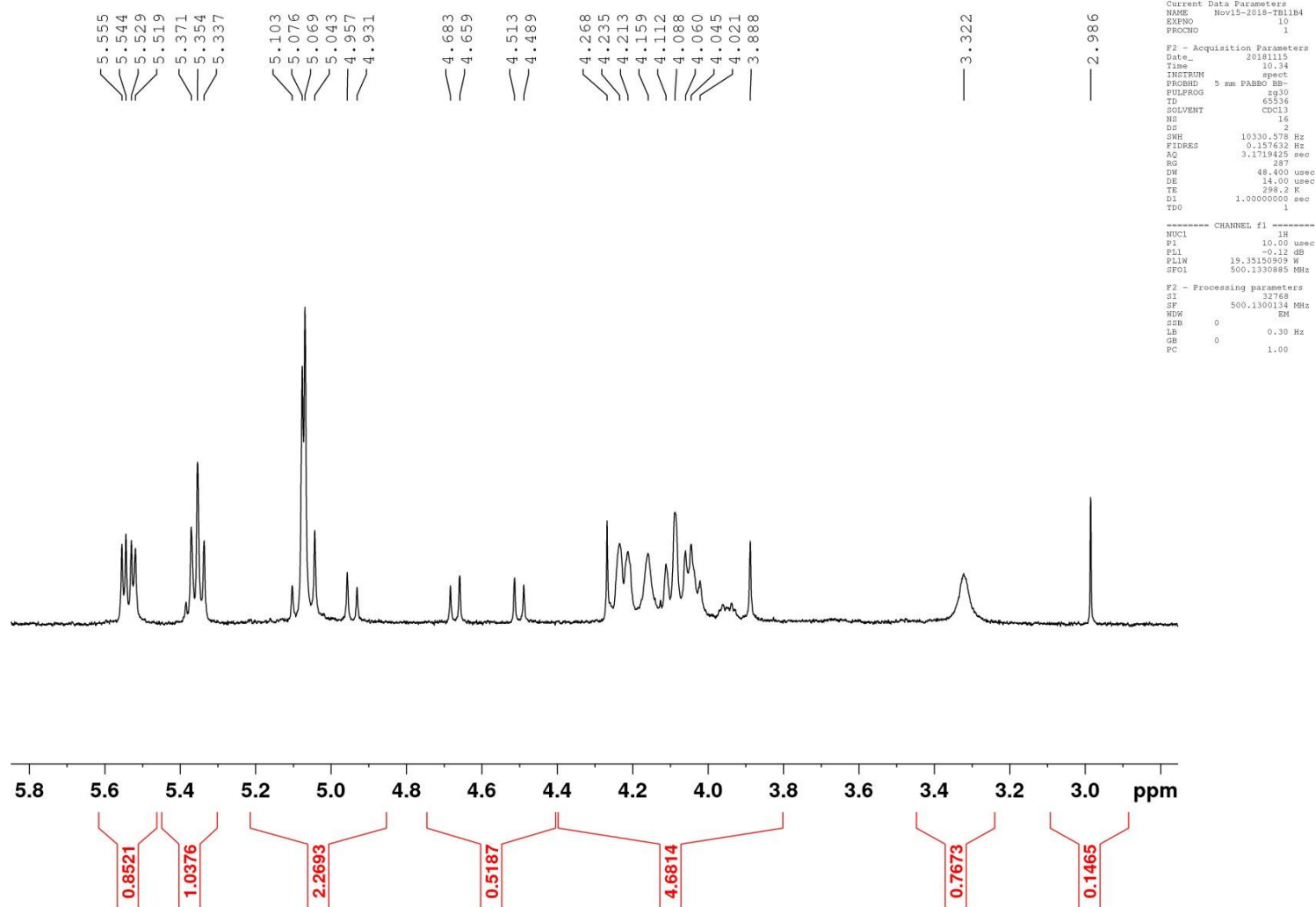
**Figure S168.**  $^1\text{H}$  NMR spectrum of **17** in  $\text{CDCl}_3$ .

TB11B4



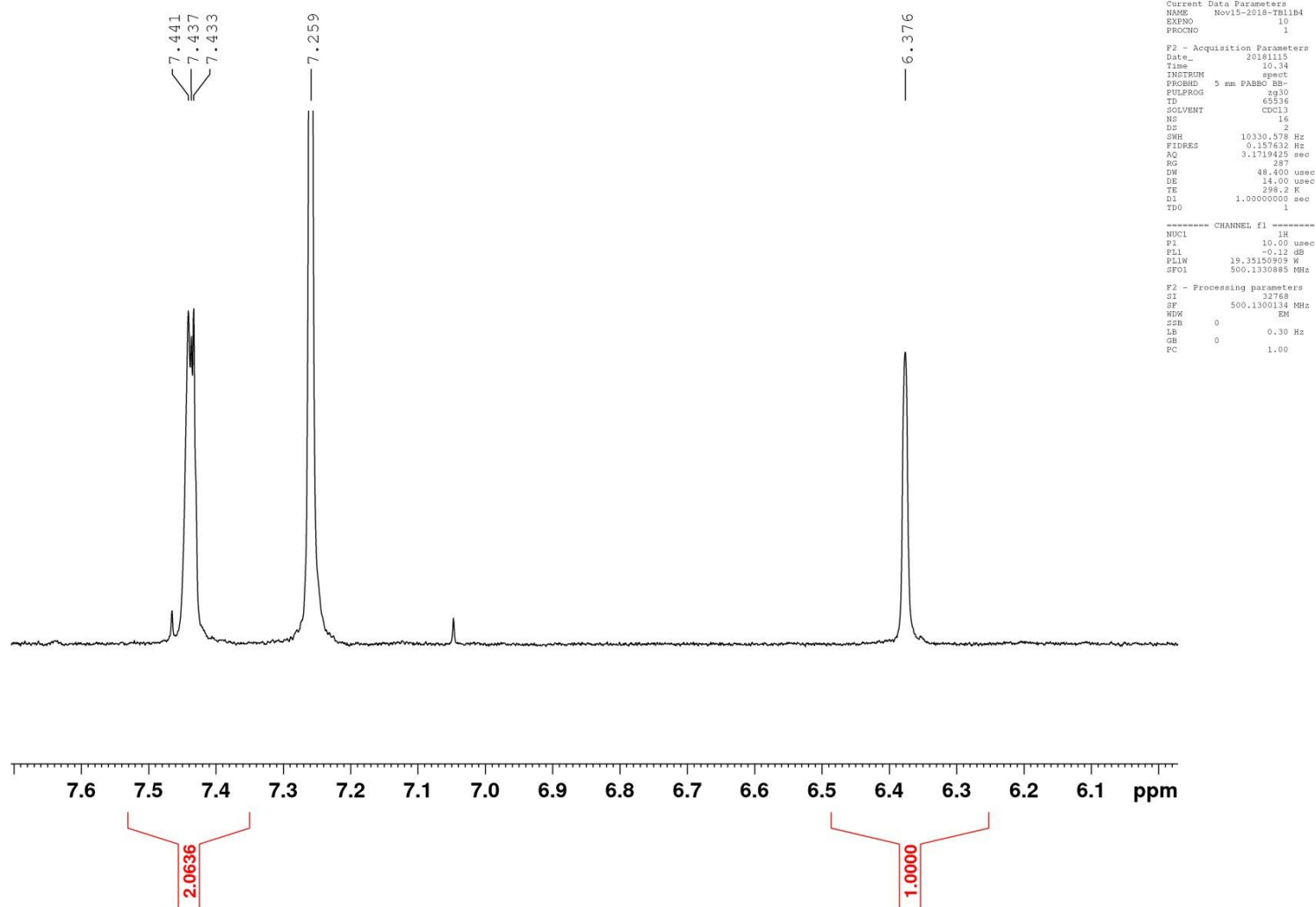
**Figure S169.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.7 –  $\delta$  3.2) of **17** in  $\text{CDCl}_3$ .

TB11B4

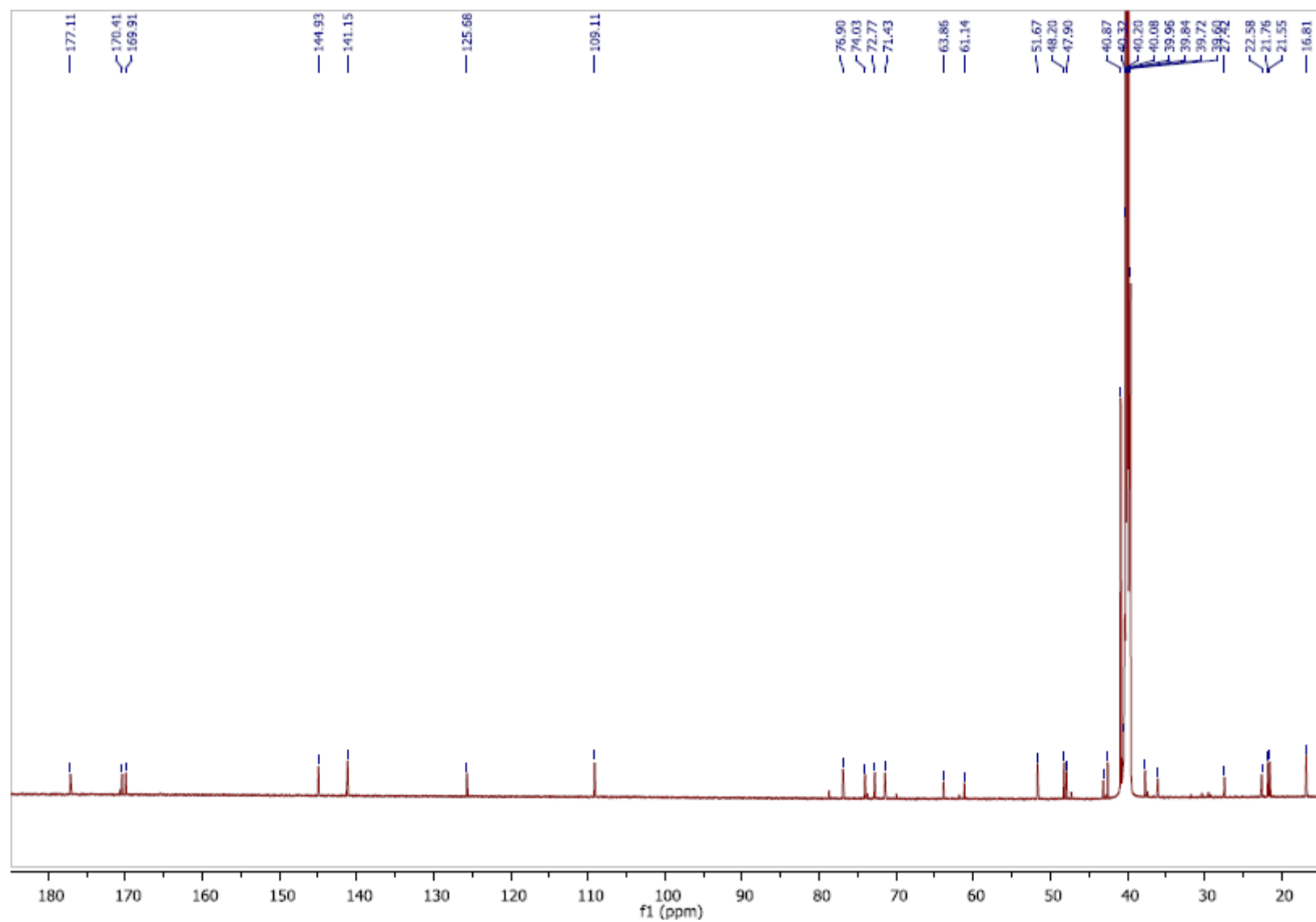


**Figure S170.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  2.8 –  $\delta$  5.8) of **17** in  $\text{CDCl}_3$ .

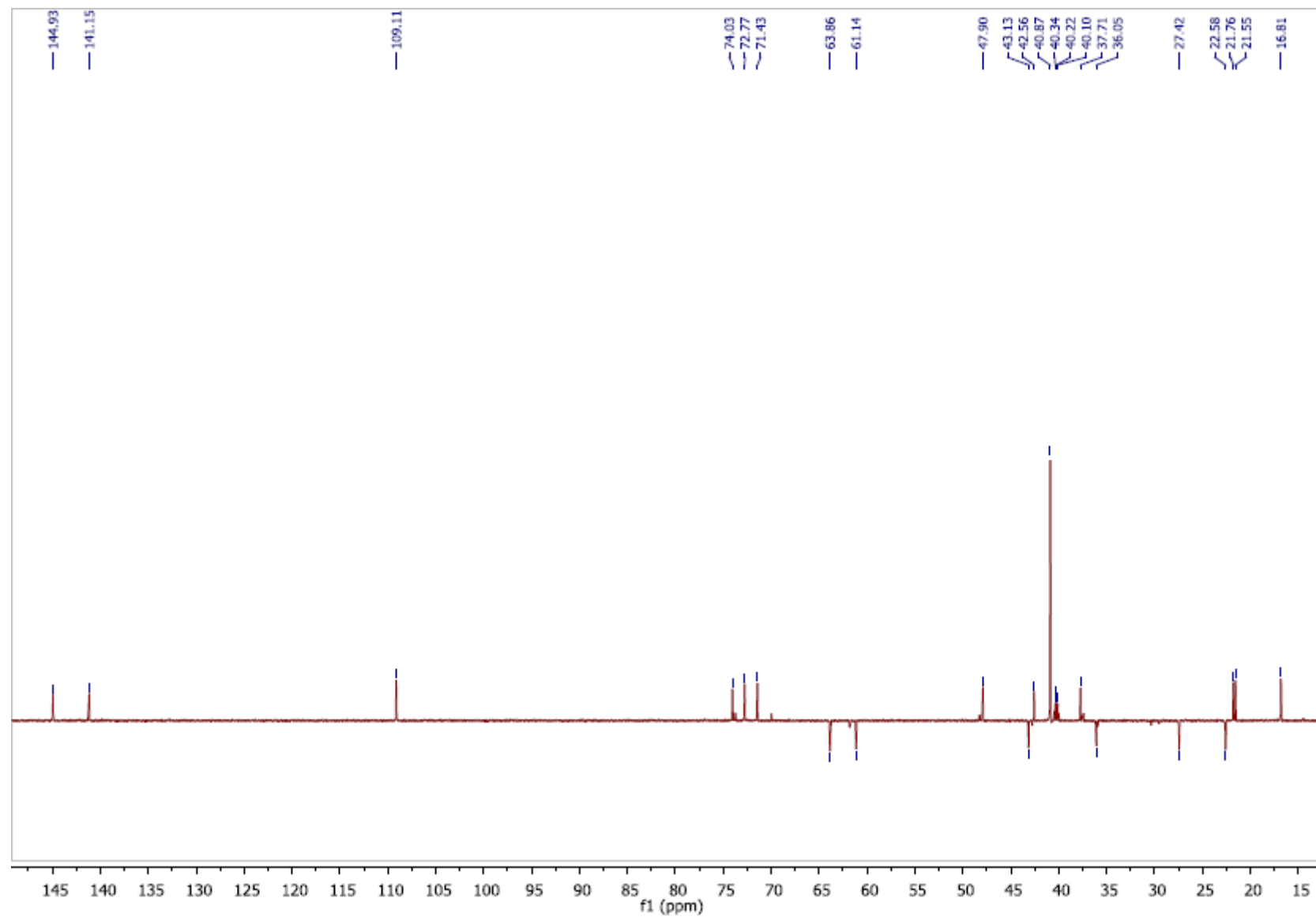
TB11B4



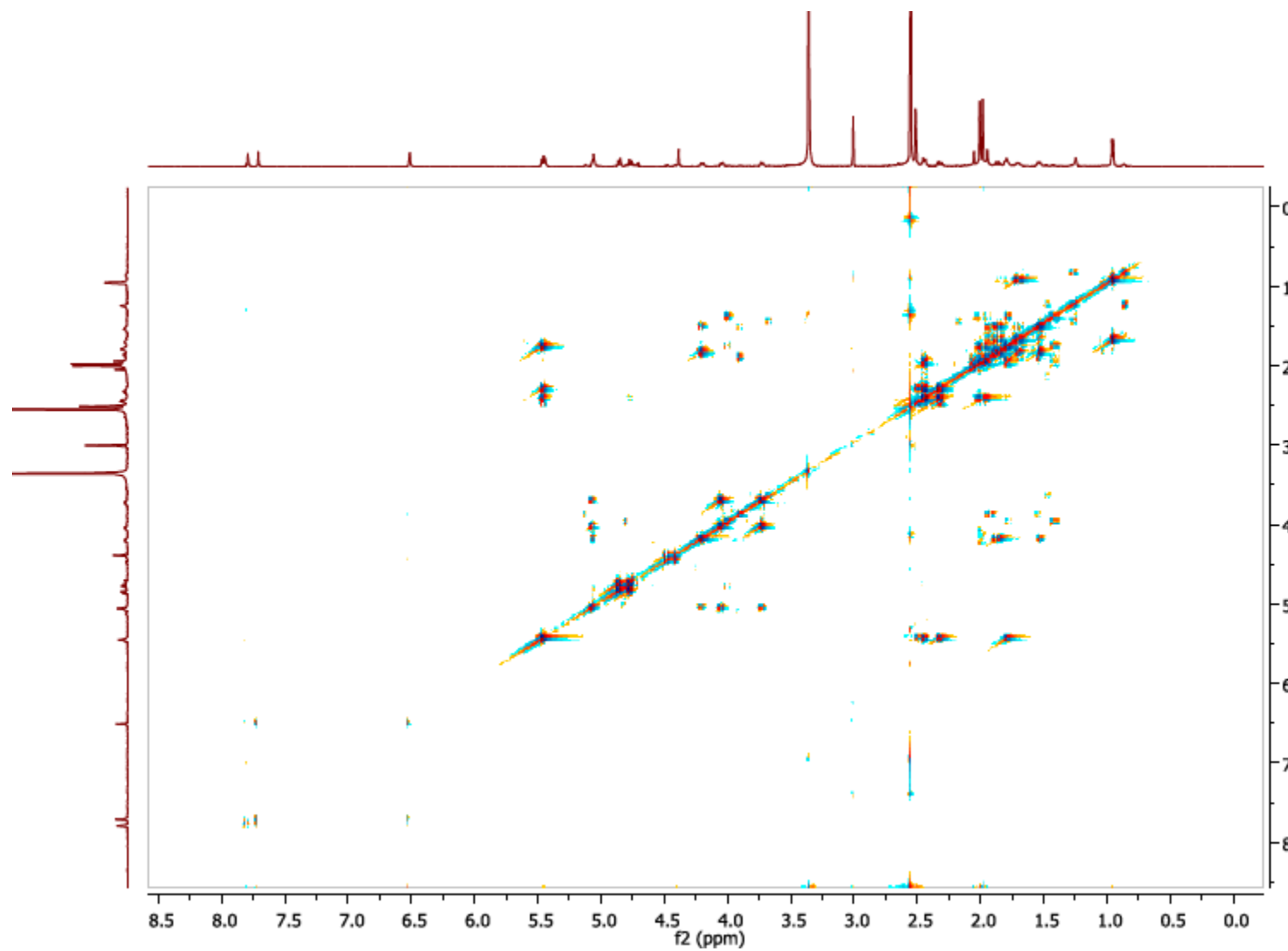
**Figure S171.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  6.0 –  $\delta$  7.7) of **17** in  $\text{CDCl}_3$ .



**Figure S172.** <sup>13</sup>C NMR spectrum of **17** in (CD<sub>3</sub>)<sub>2</sub>SO.



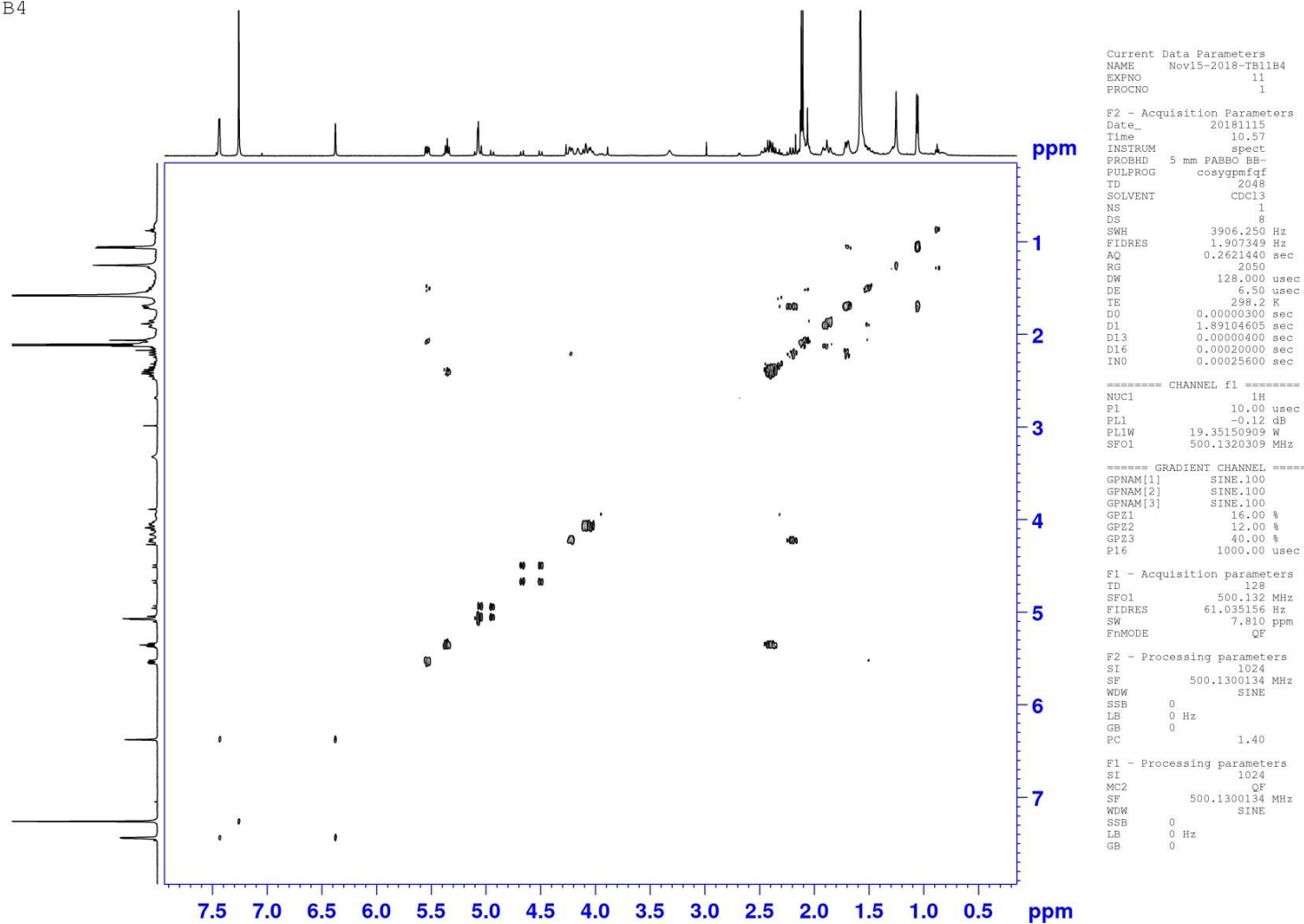
**Figure S173.** 135DEPT NMR spectrum of **17** in  $(\text{CD}_3)_2\text{SO}$ .



**Figure S174.** COSY NMR spectrum of **17** in  $(\text{CD}_3)_2\text{SO}$ .

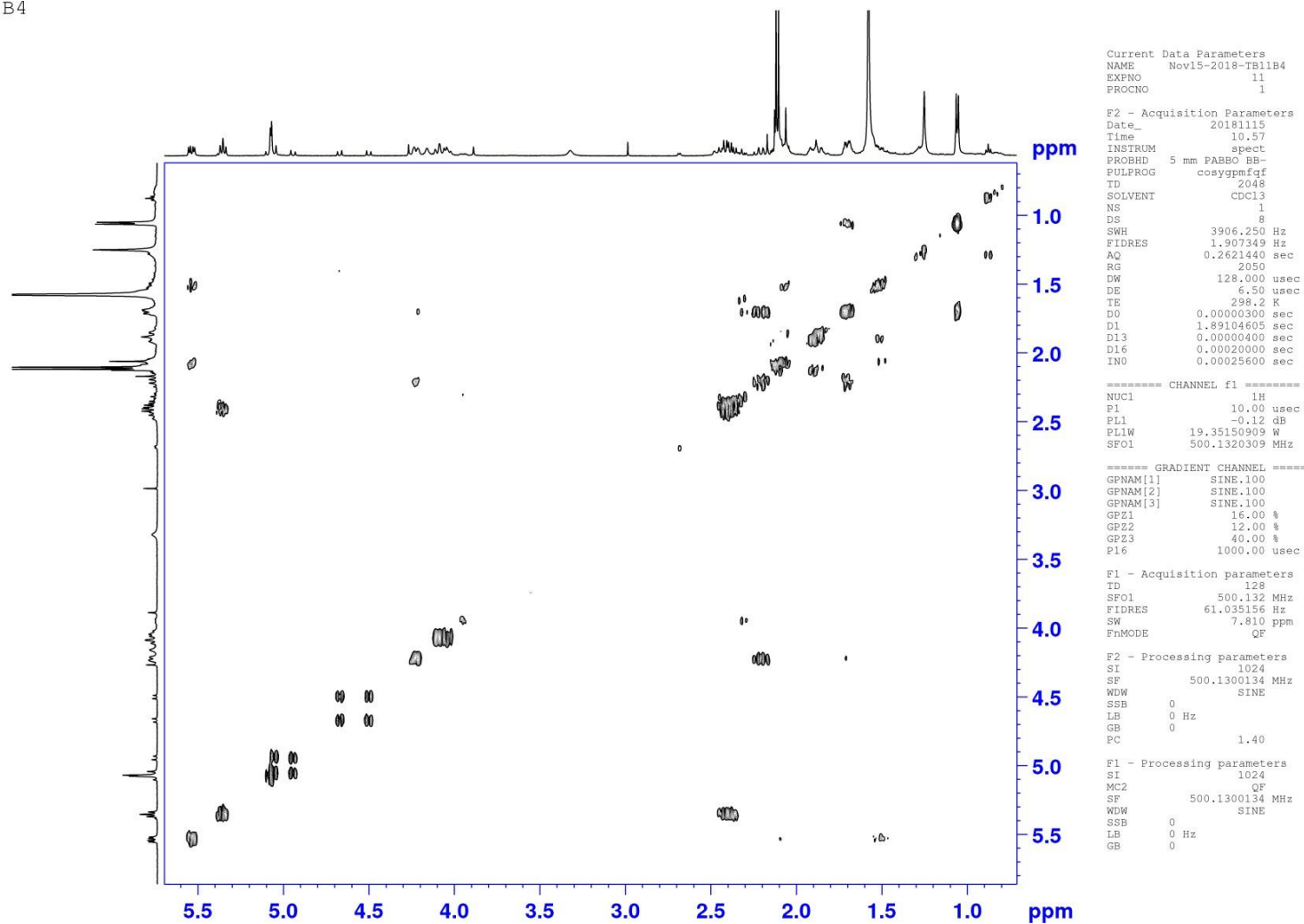


TB11B4

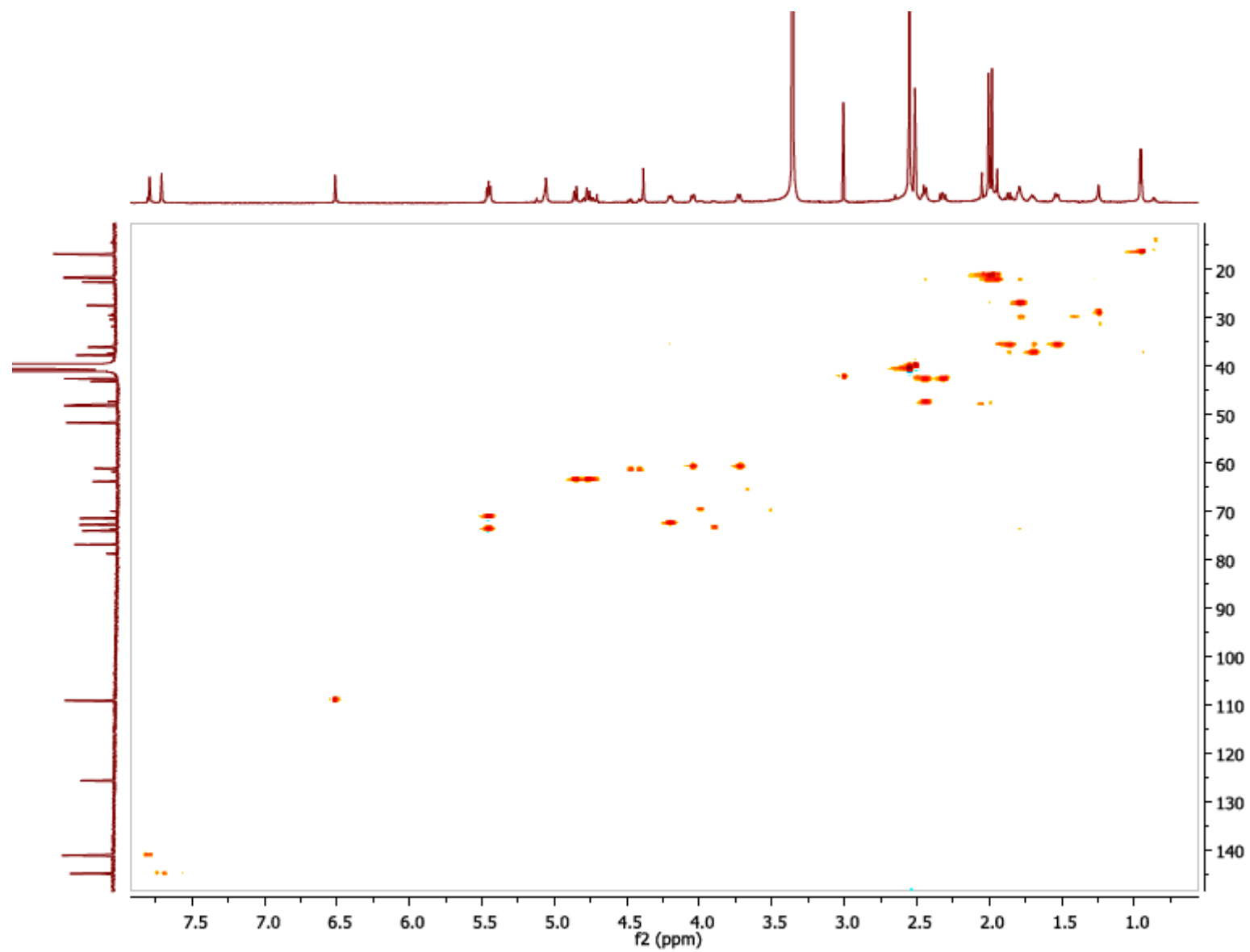


**Figure S175.** COSY NMR spectrum of **17** in CDCl<sub>3</sub>.

TB11B4

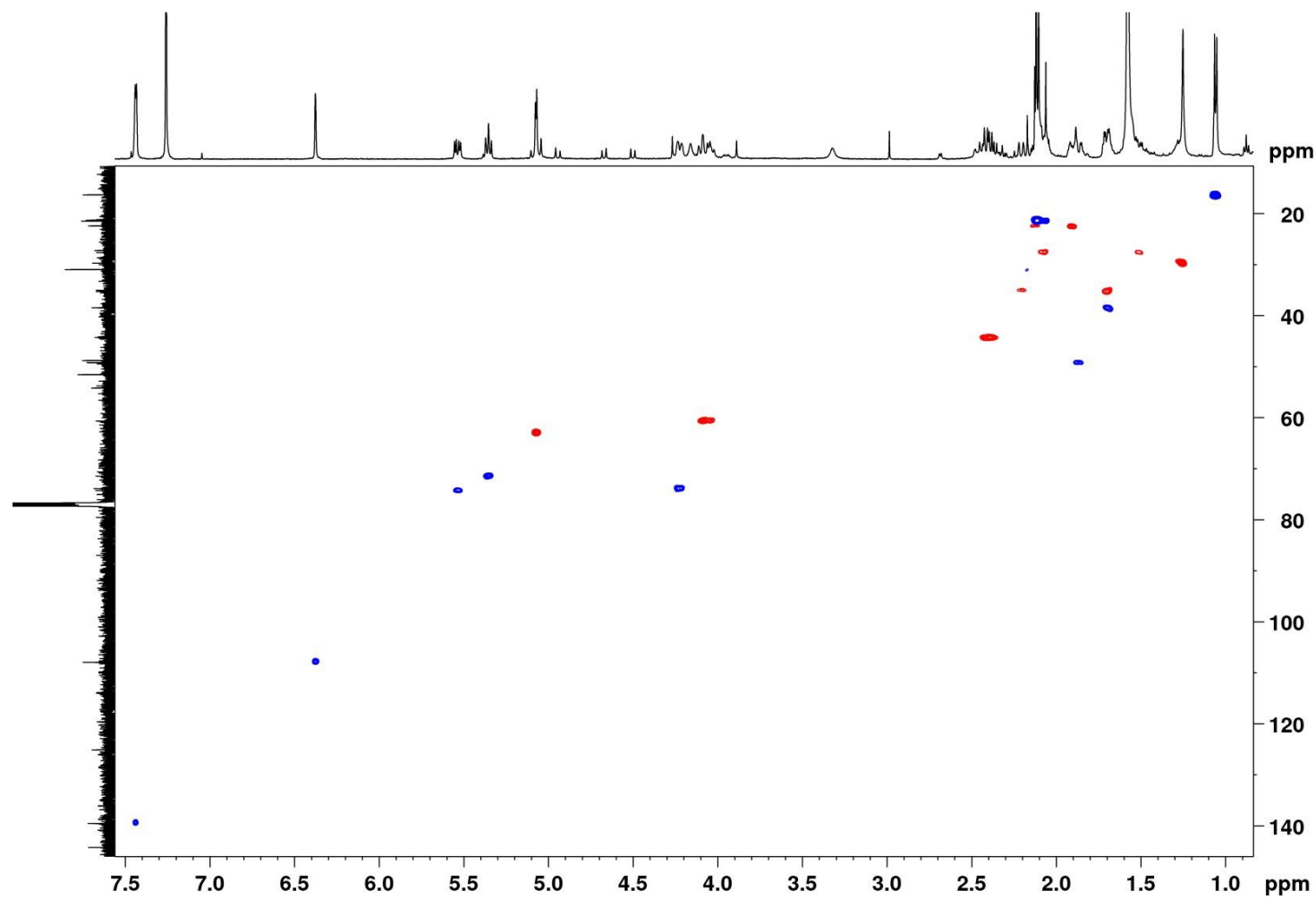


**Figure S176.** Expansion of part of COSY NMR spectrum ( $\delta$  0.5 –  $\delta$  5.5) of **17** in  $\text{CDCl}_3$ .



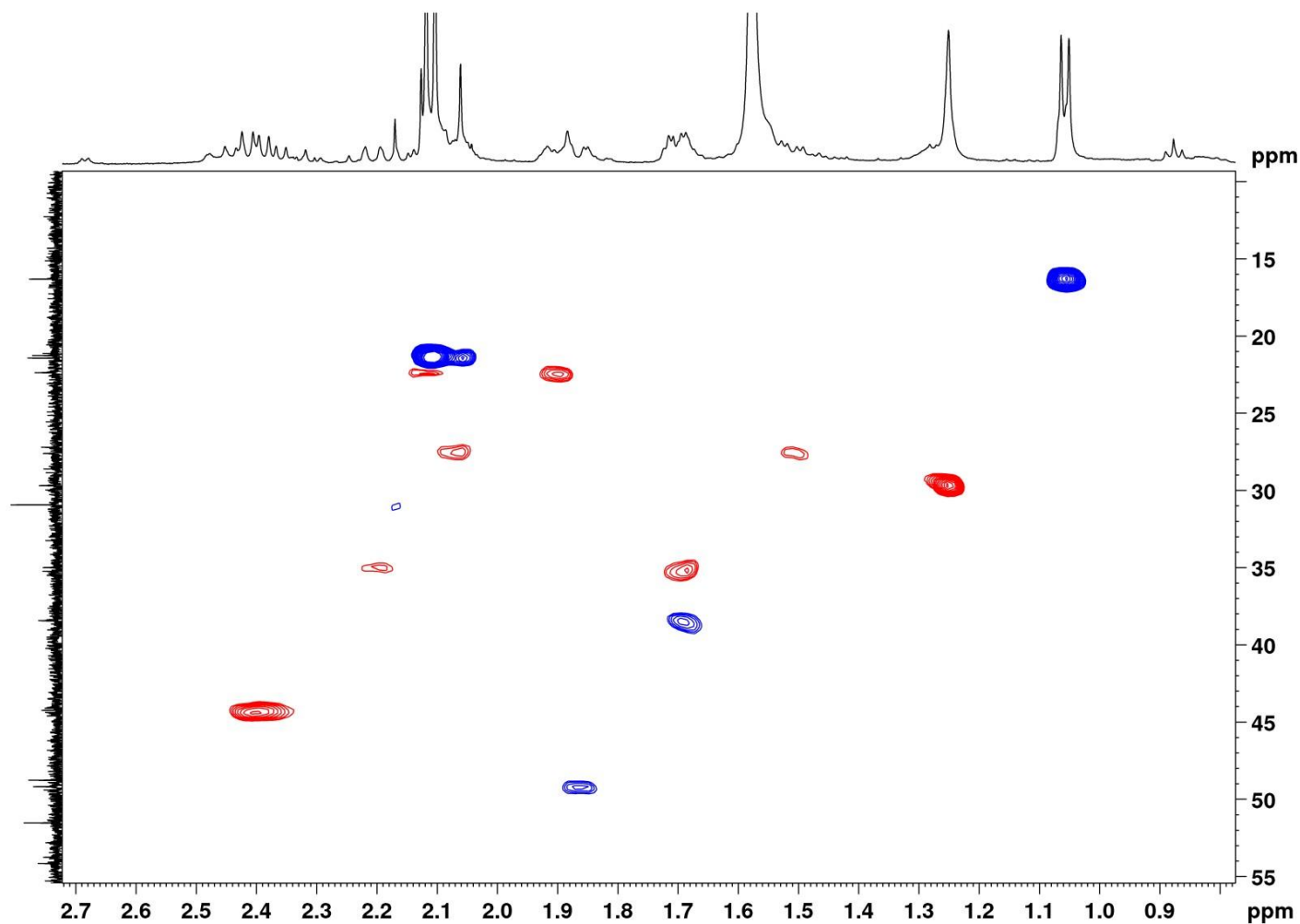
**Figure S177.** HSQC NMR spectrum of **17** in  $(\text{CD}_3)_2\text{SO}$ .

TB11B4



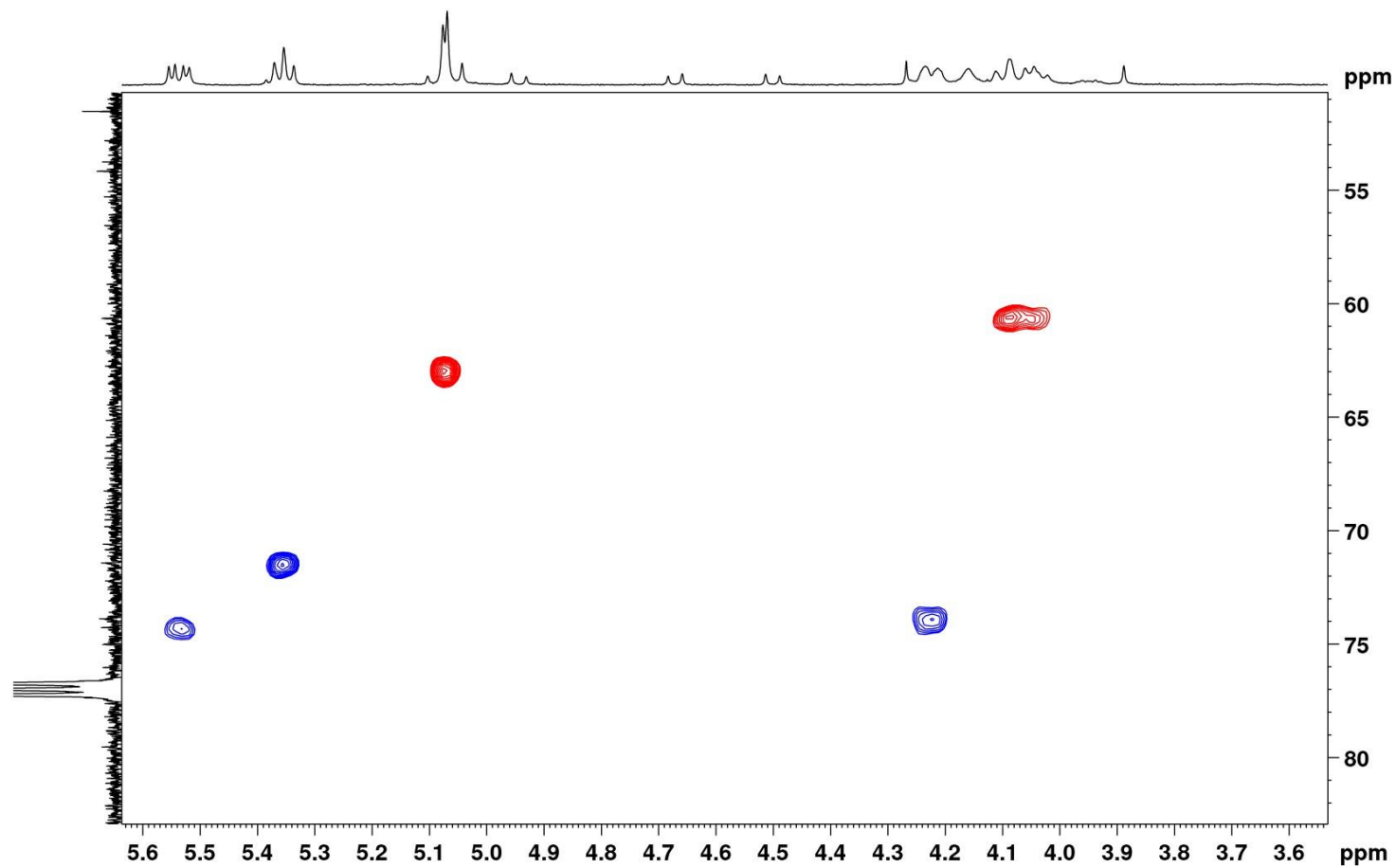
**Figure S178.** HSQC NMR spectrum of **17** in  $\text{CDCl}_3$ .

TB11B4

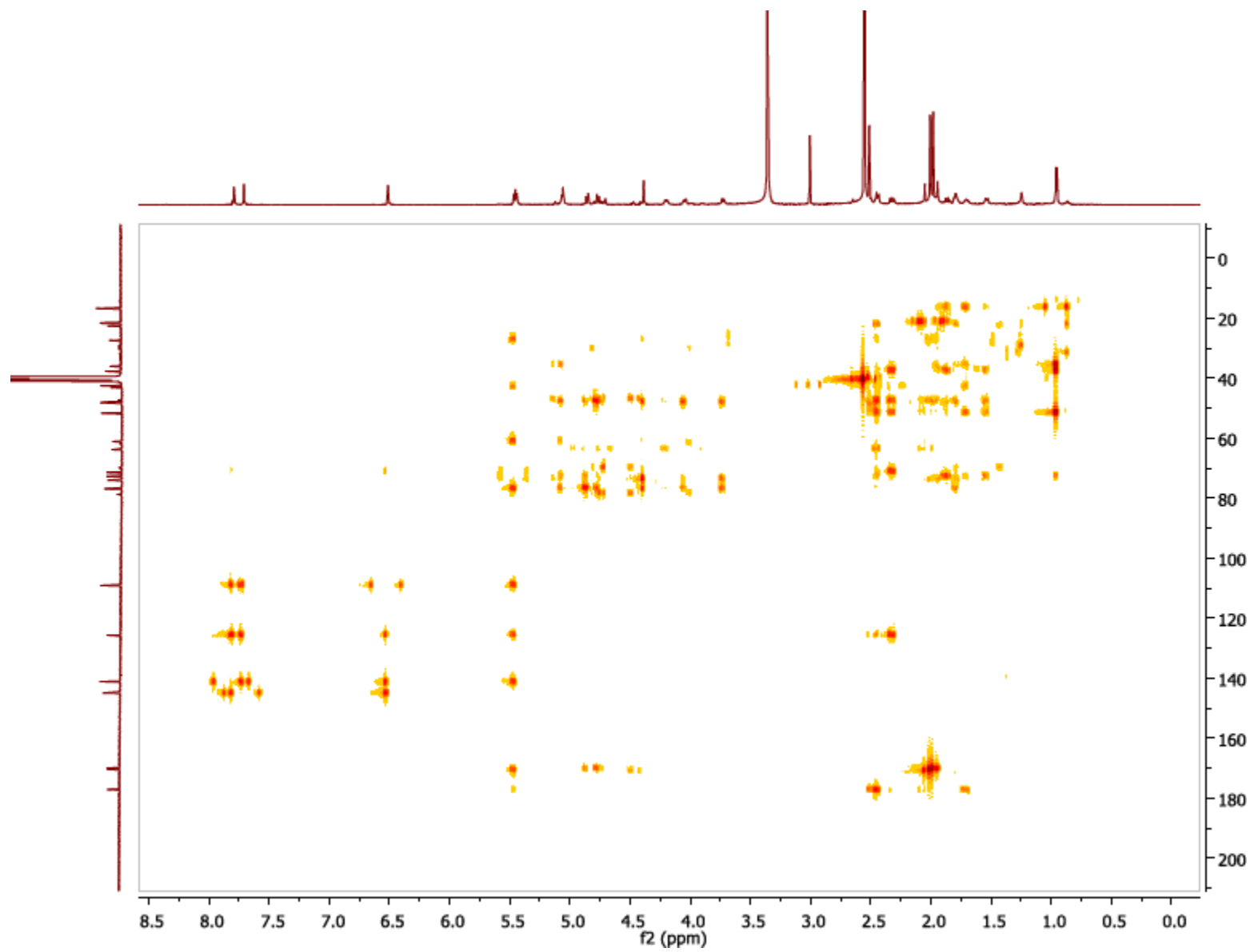


**Figure S179.** Expansion of part of HSQC NMR spectrum ( $\delta$  0.8 –  $\delta$  2.7) of **17** in  $\text{CDCl}_3$ .

TB11B4

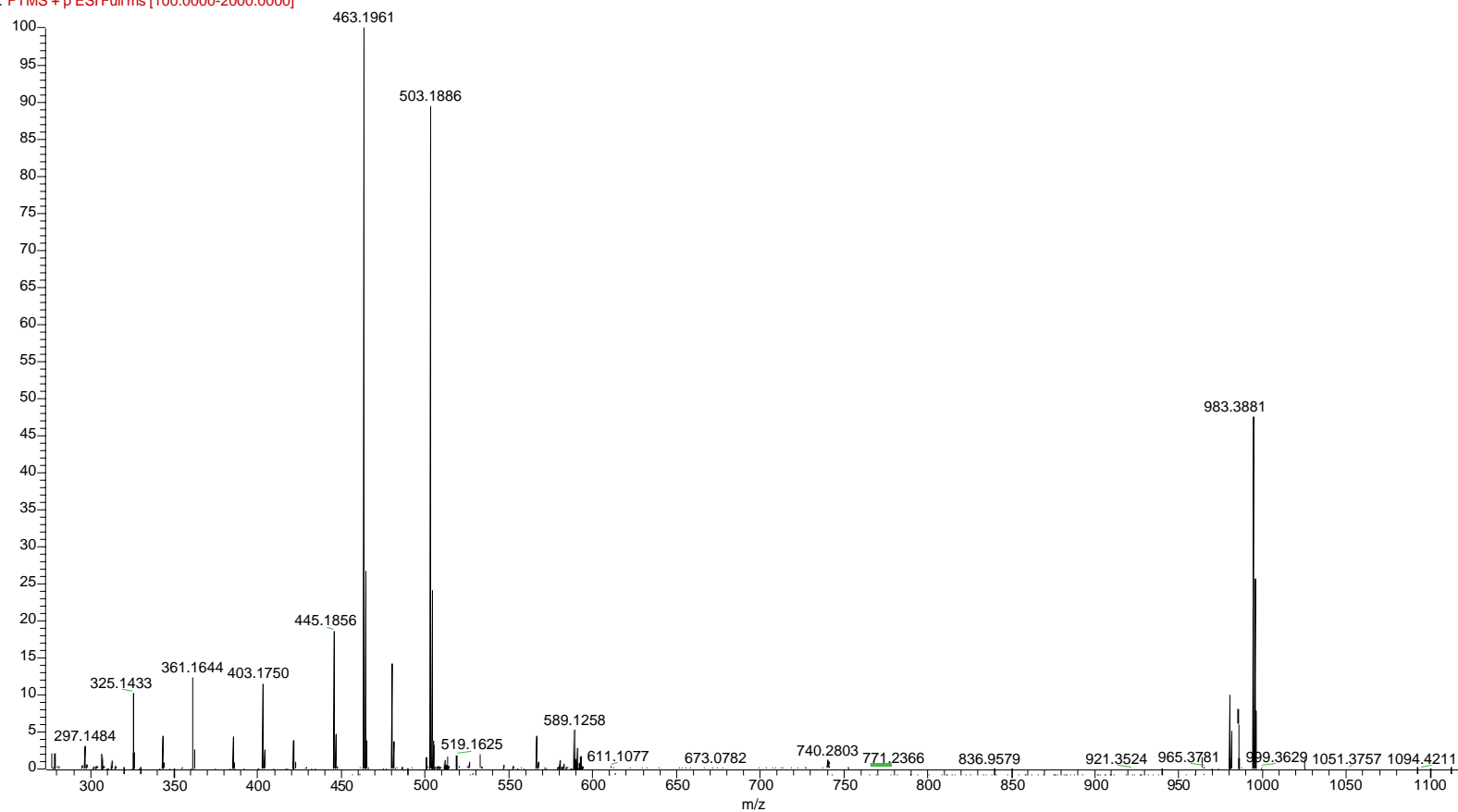


**Figure S180.** Expansion of part of HSQC NMR spectrum ( $\delta$  3.6 –  $\delta$  5.6) of **17** in  $\text{CDCl}_3$ .



**Figure S181.** HMBC NMR spectrum of **17** in  $(\text{CD}_3)_2\text{SO}$ .

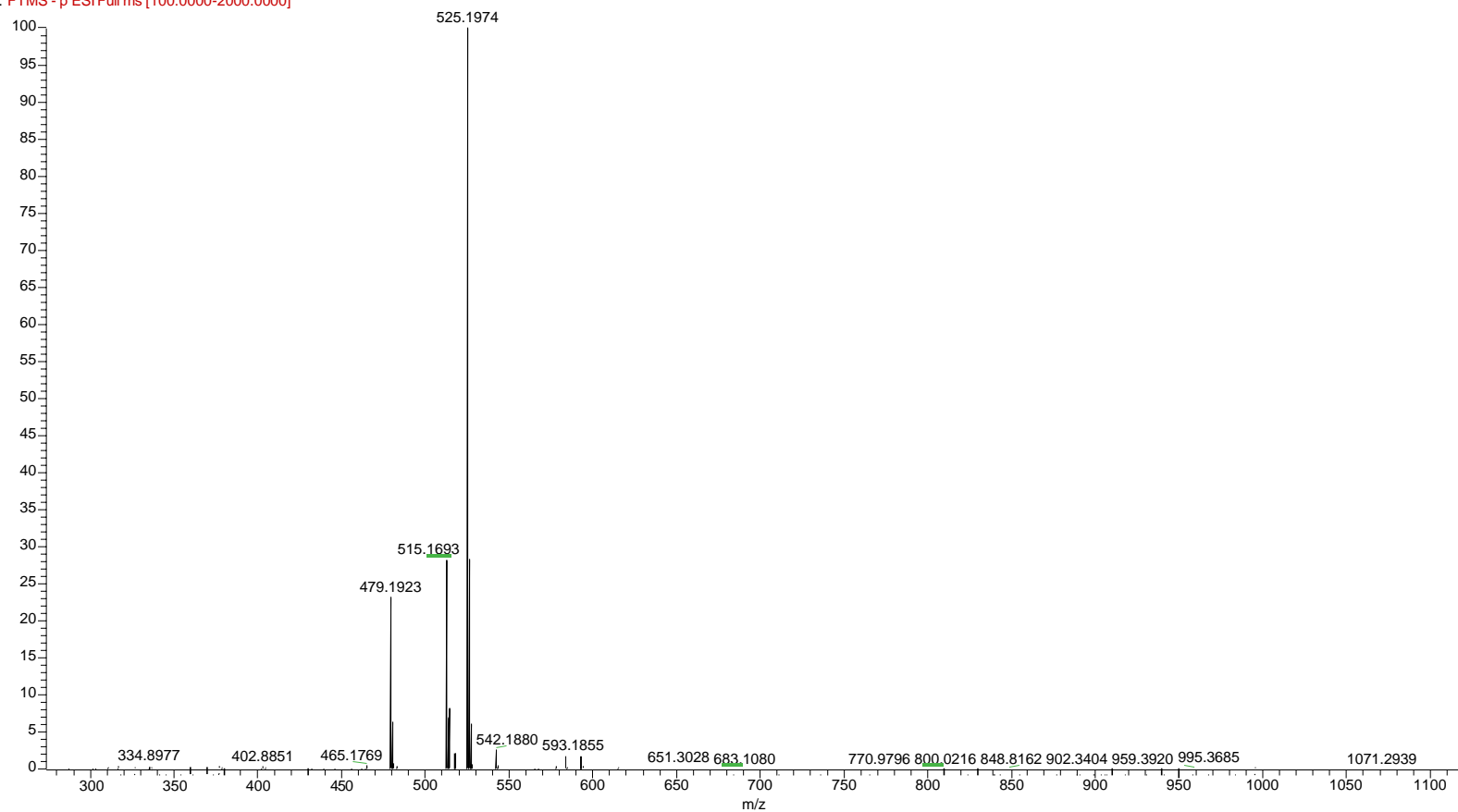
R1 #301-322 RT: 4.32-4.60 AV: 11 NL: 2.71E7  
F: FTMS + p ESI Full ms [100.0000-2000.0000]



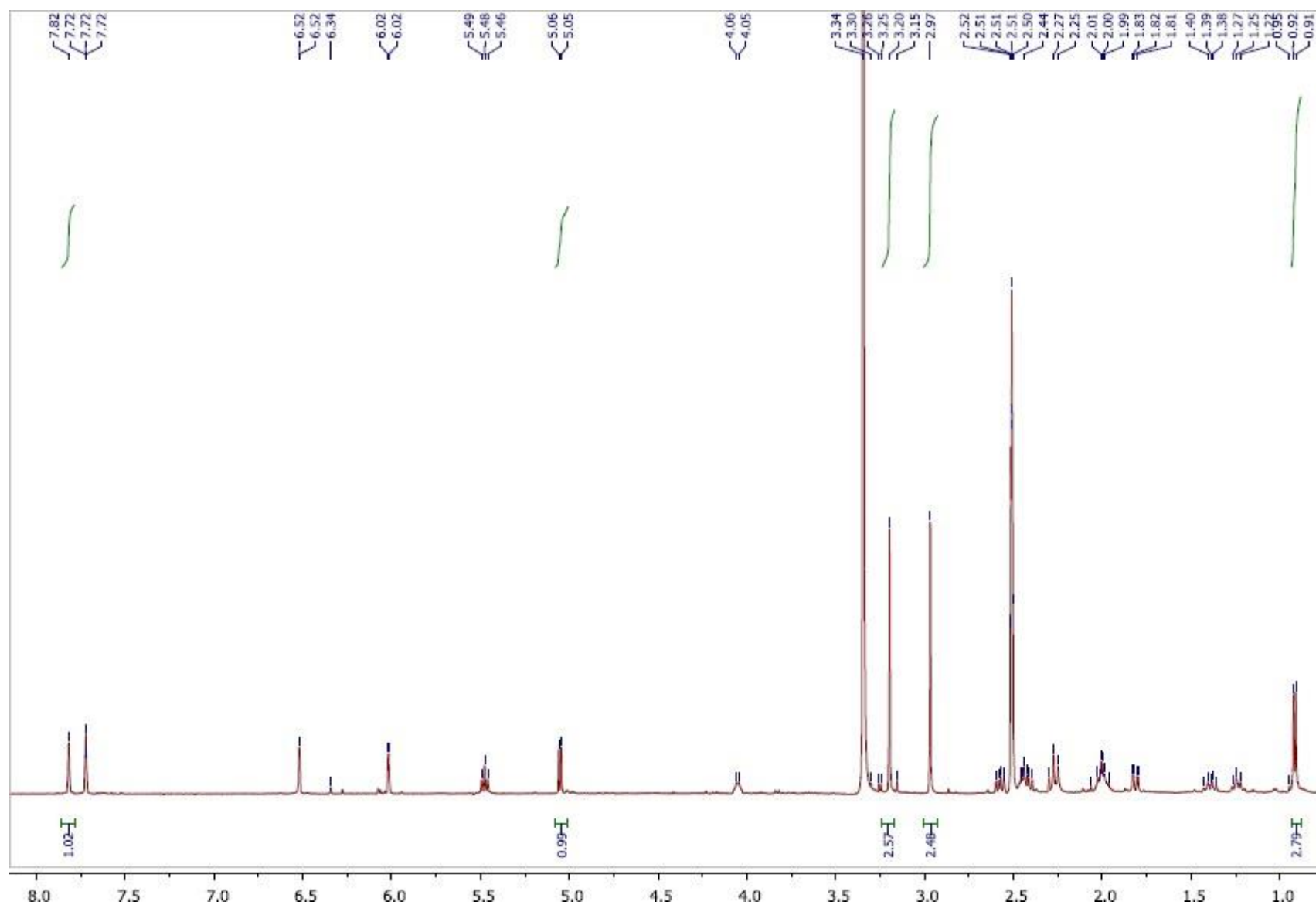


**Figure S182.** Positive-ion HRESIMS of **17**.

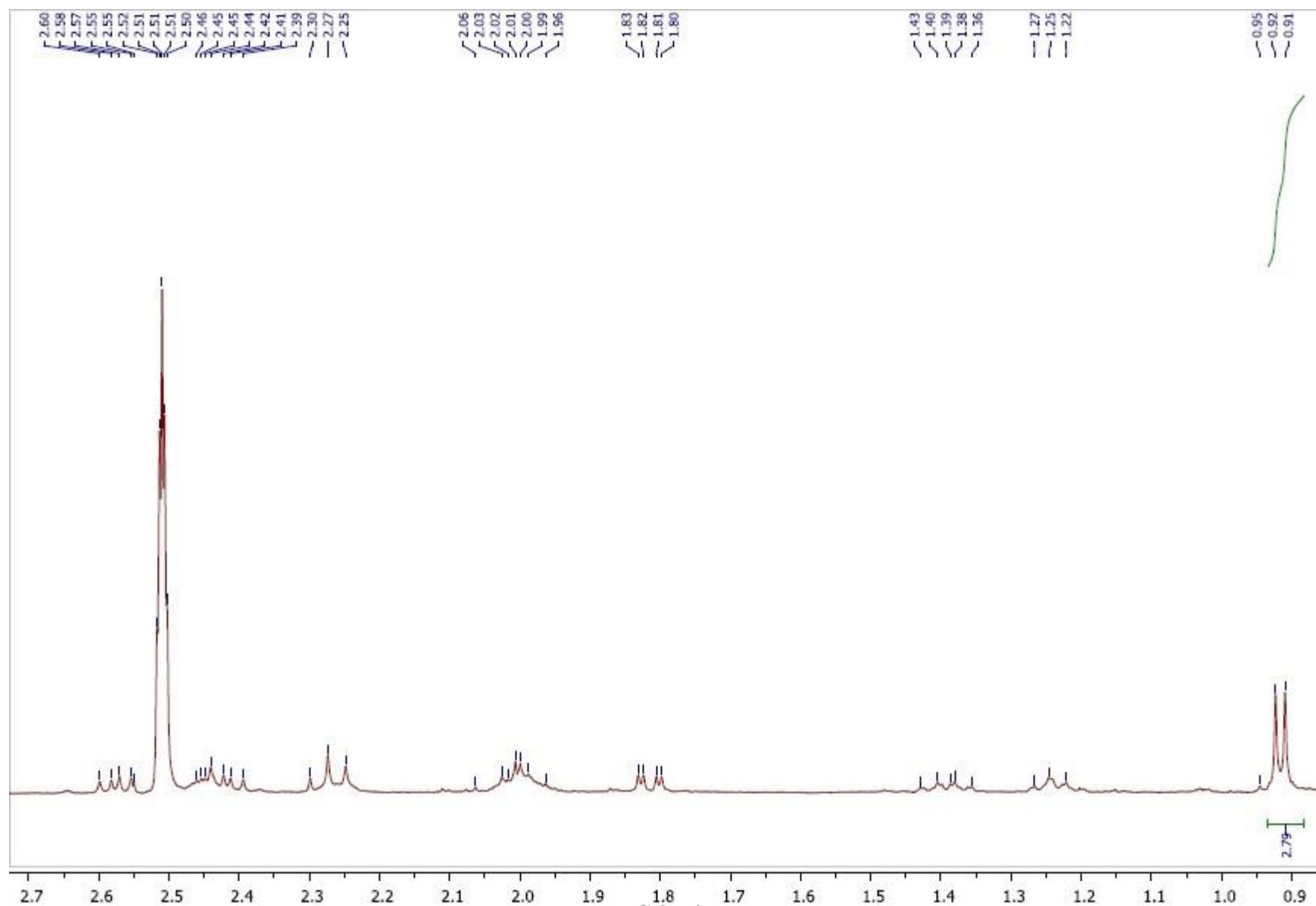
R1 #301-322 RT: 4.34-4.61 AV: 11 NL: 6.35E6  
F: FTMS - p ESI Full ms [100.0000-2000.0000]



**Figure S183.** Negative-ion HRESIMS of **17**.



**Figure S184.**  $^1\text{H}$  NMR spectrum of **18** in  $(\text{CD}_3)_2\text{SO}$ .



**Figure S185.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.9 –  $\delta$  2.7) of **18** in  $(\text{CD}_3)_2\text{SO}$ .

TB7-4

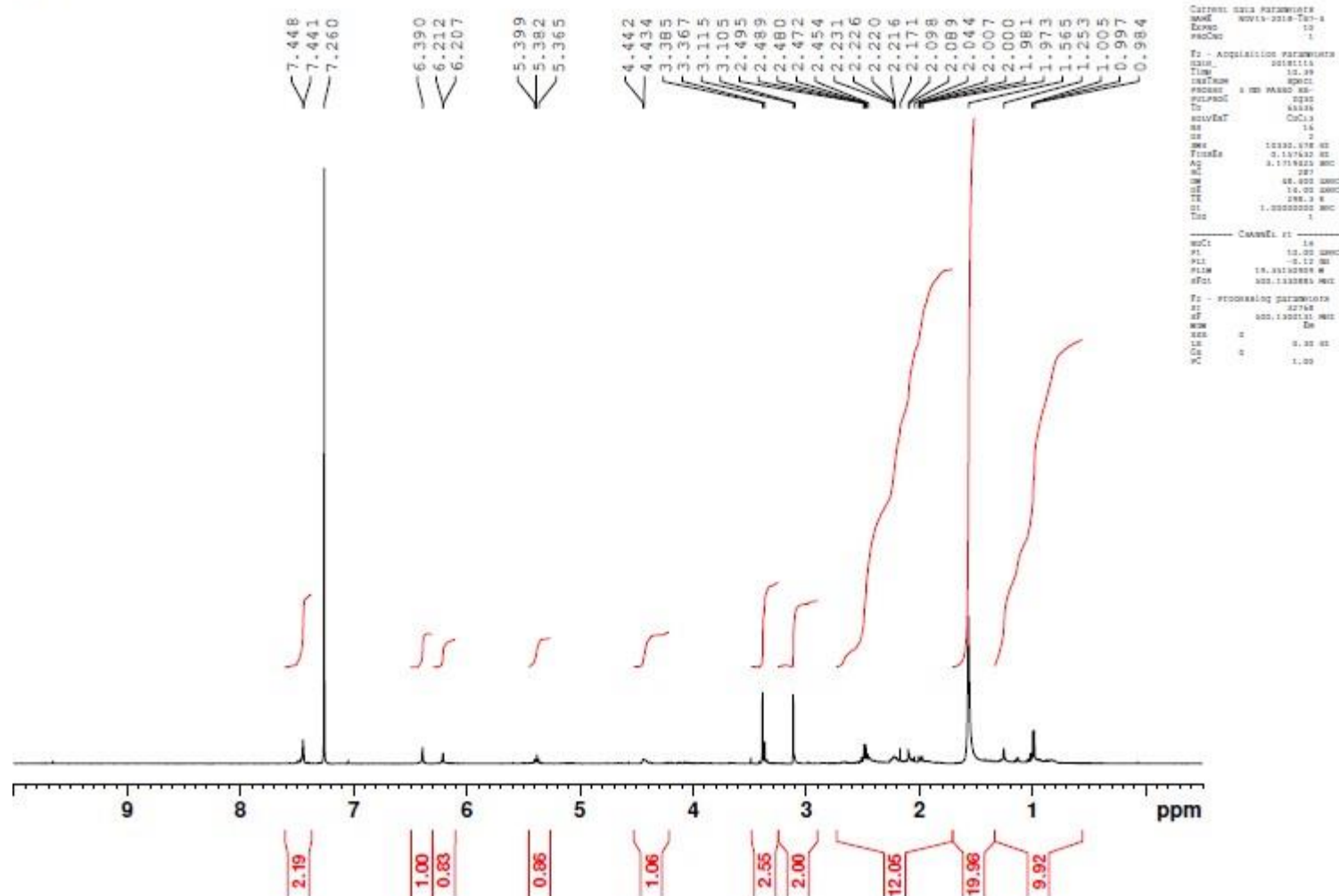
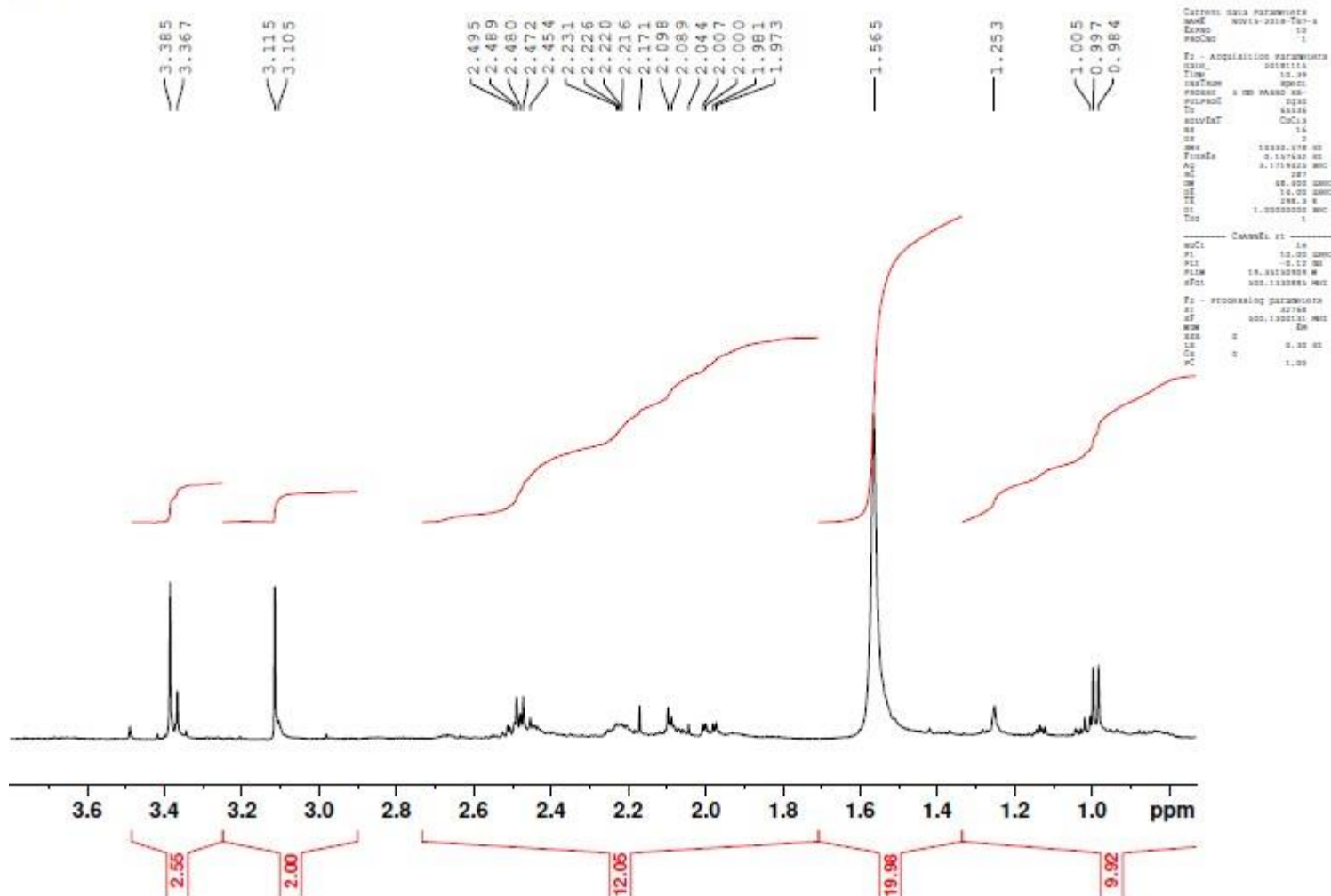
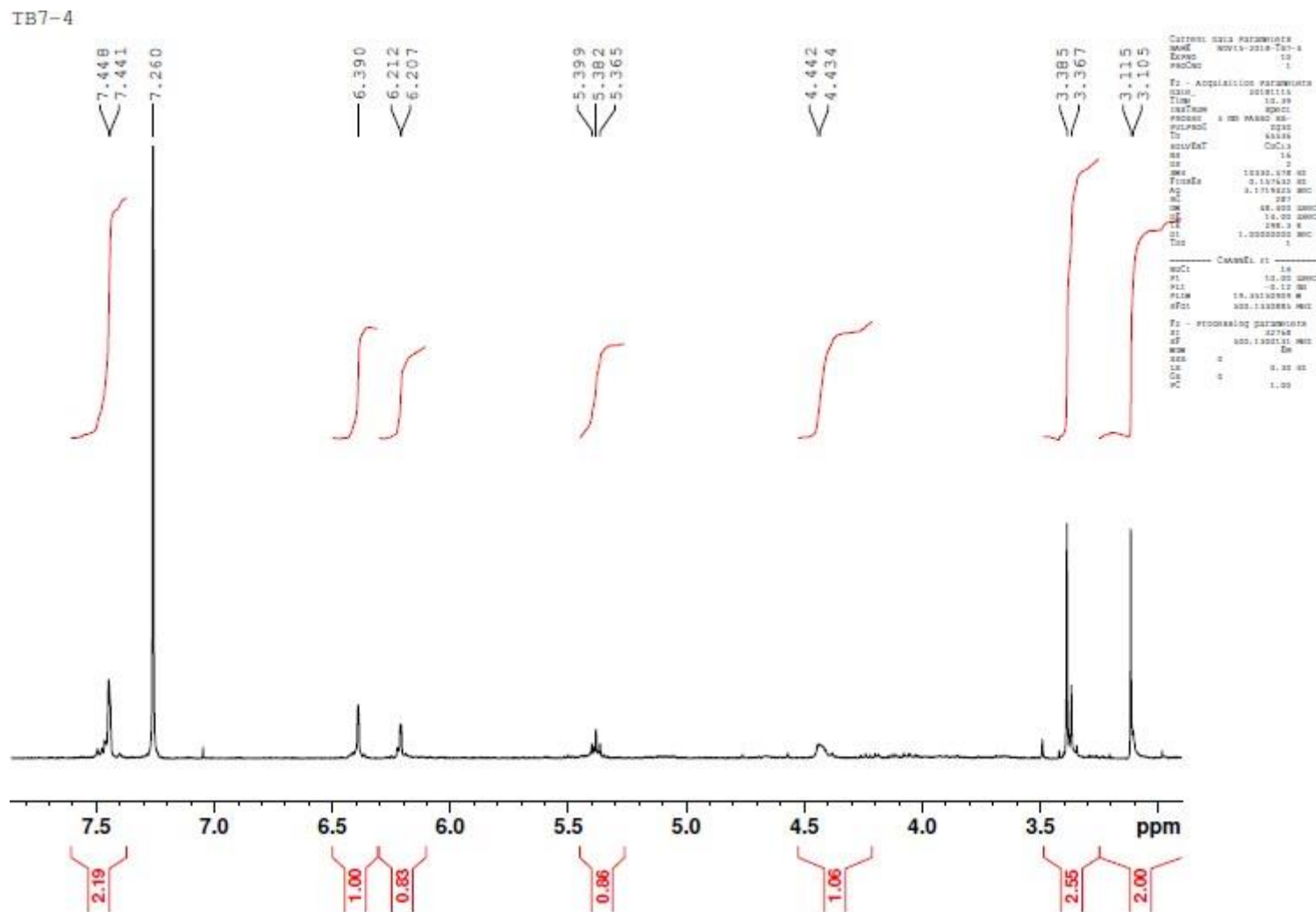


Figure S186.  $^1\text{H}$  NMR spectrum of **18** in  $\text{CDCl}_3$ .

TB7-4

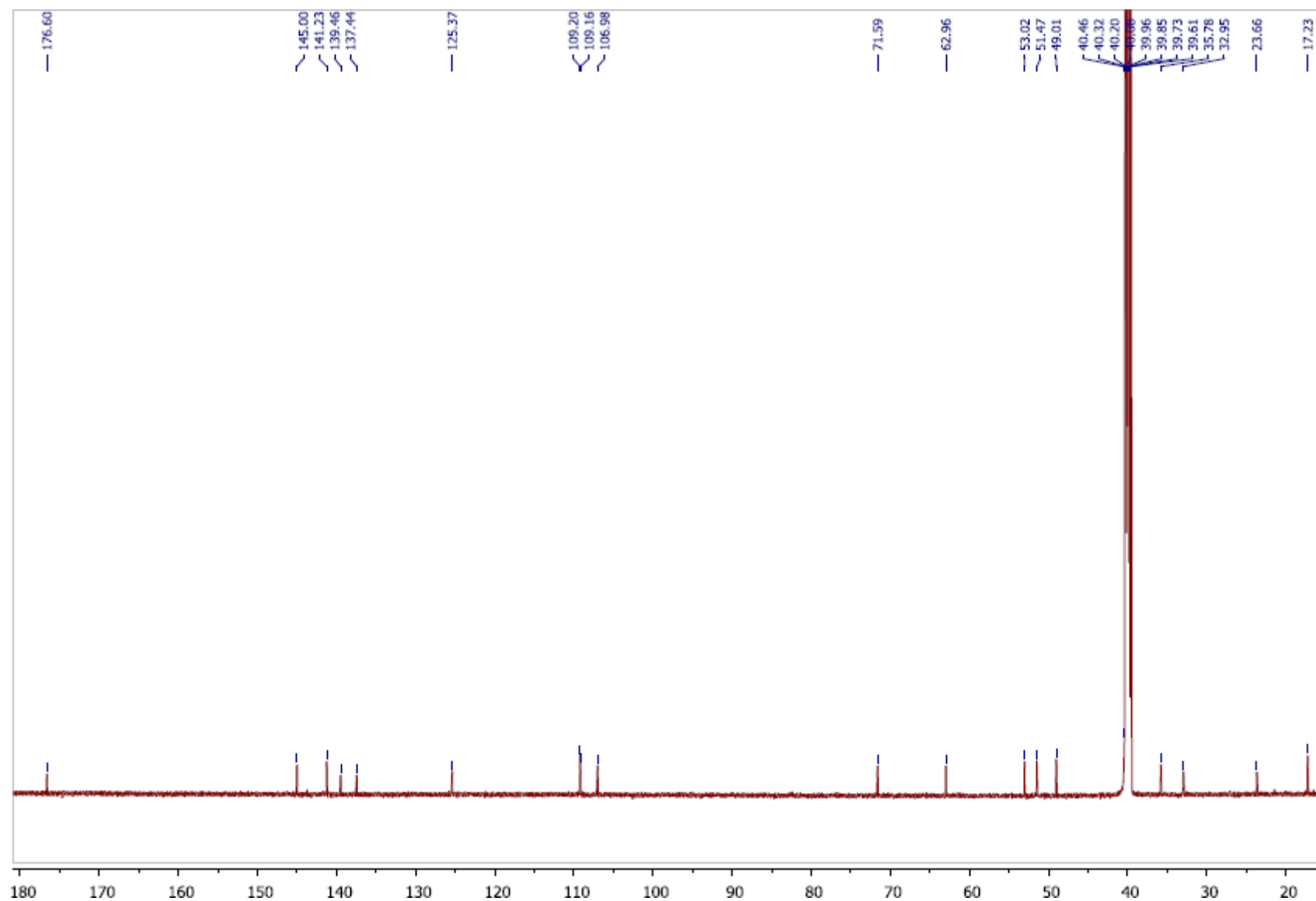


**Figure S187.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.8 –  $\delta$  3.7) of **18** in  $\text{CDCl}_3$ .

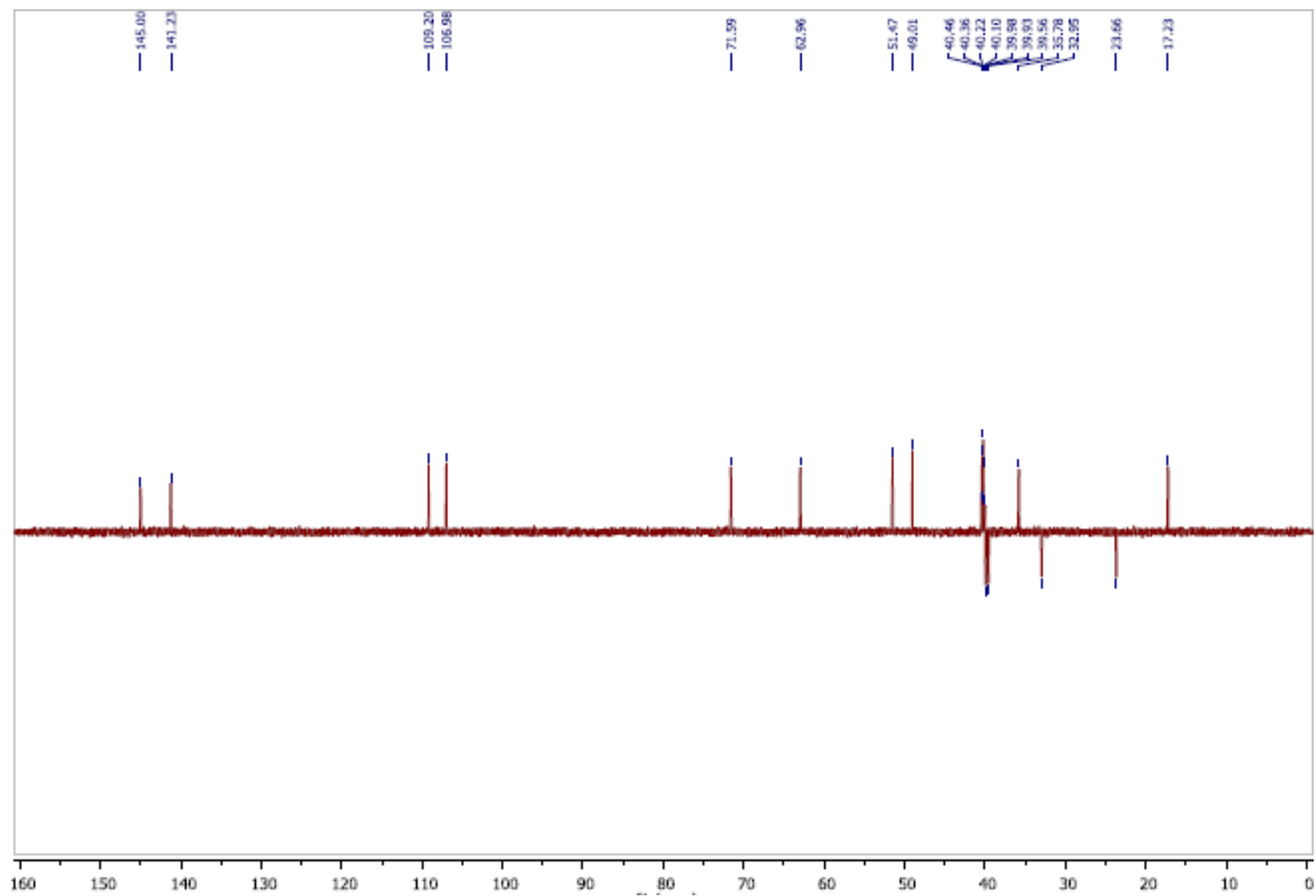


**Figure S188.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  3.0 –  $\delta$  7.8) of **18** in  $\text{CDCl}_3$ .

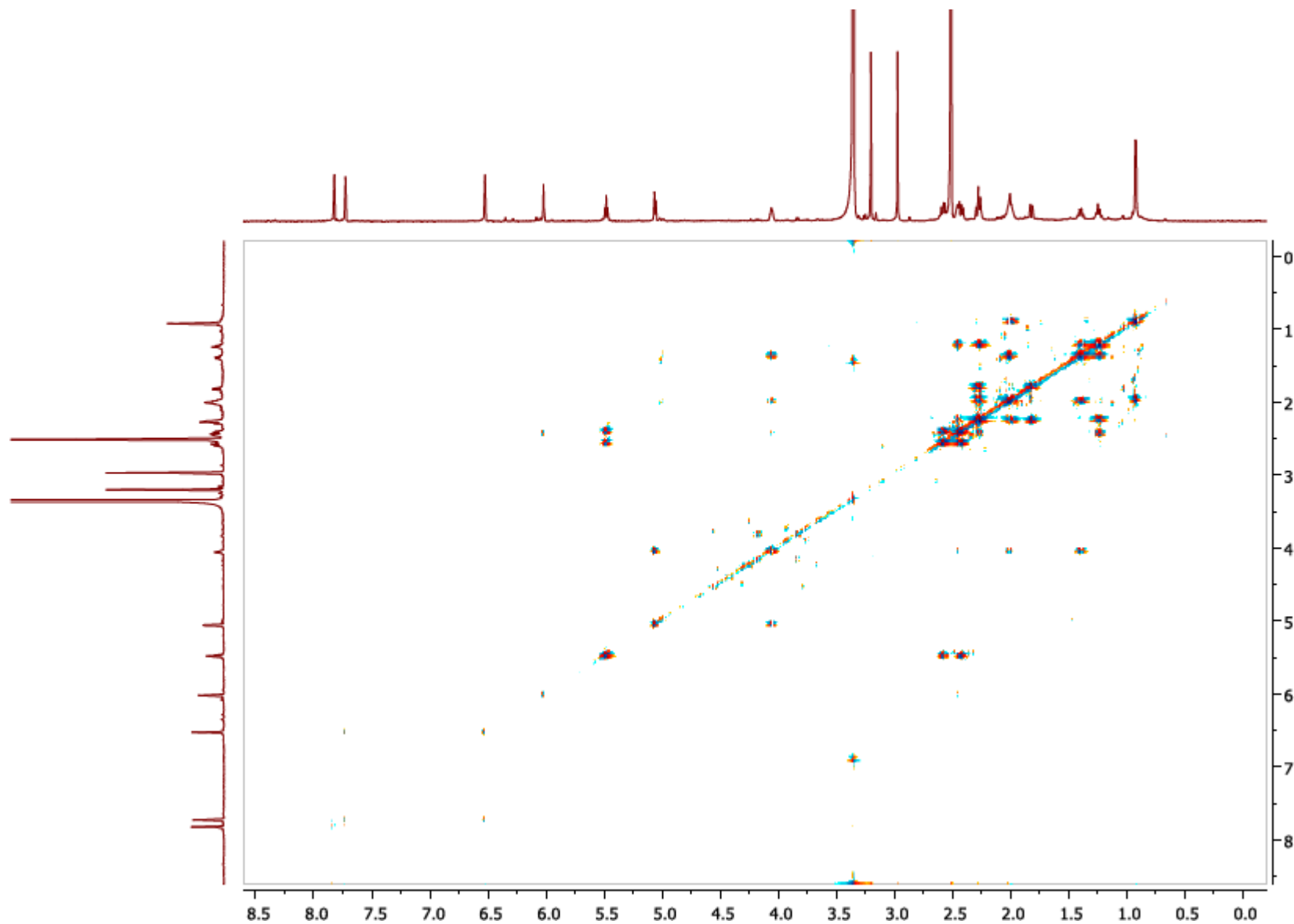




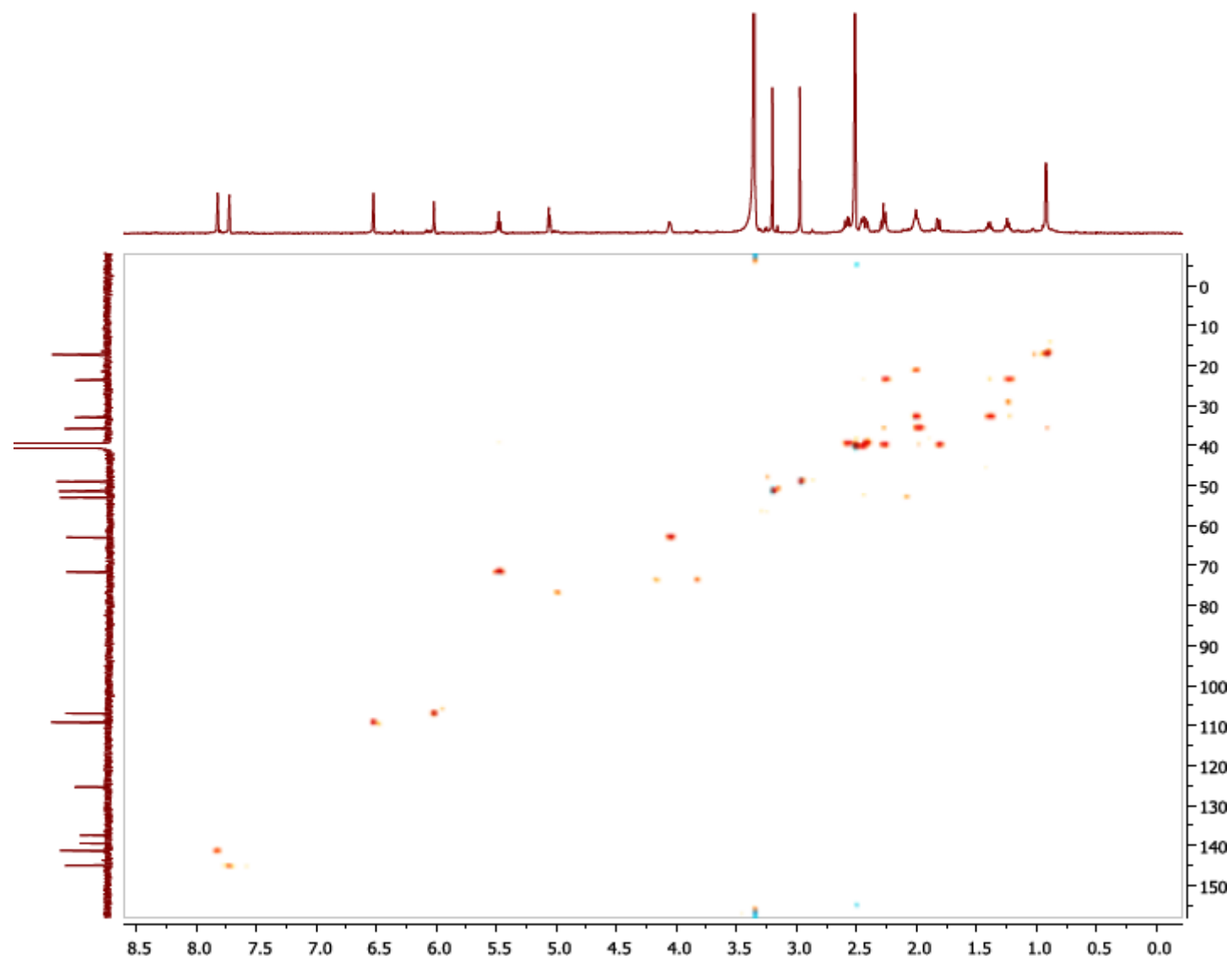
**Figure S189.** <sup>13</sup>C NMR spectrum of **18** in (CD<sub>3</sub>)<sub>2</sub>SO.



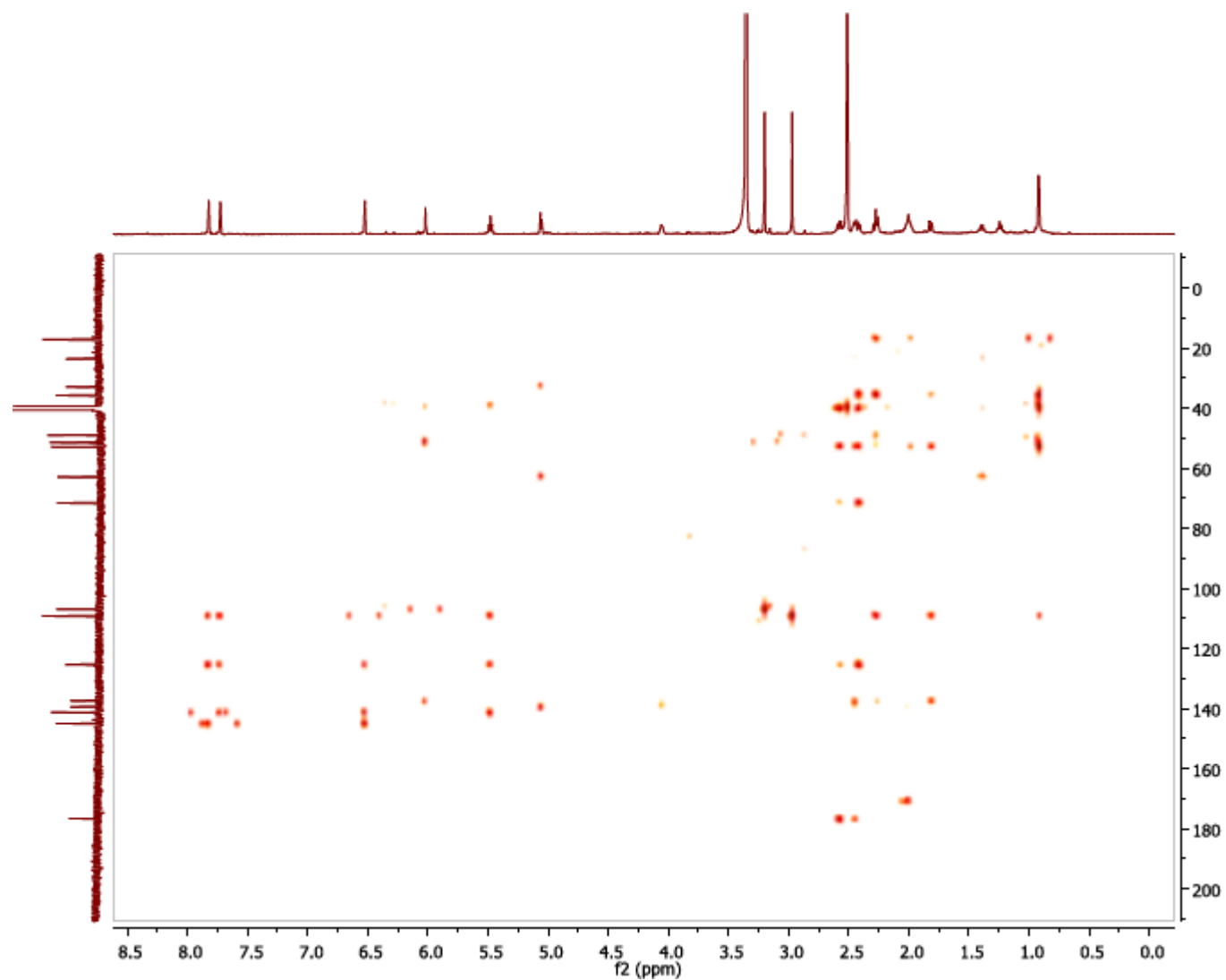
**Figure S190.**  $^{13}\text{C}$ DEPT NMR spectrum of **18** in  $(\text{CD}_3)_2\text{SO}$ .



**Figure S191.** COSY NMR spectrum of **18** in  $(\text{CD}_3)_2\text{SO}$ .

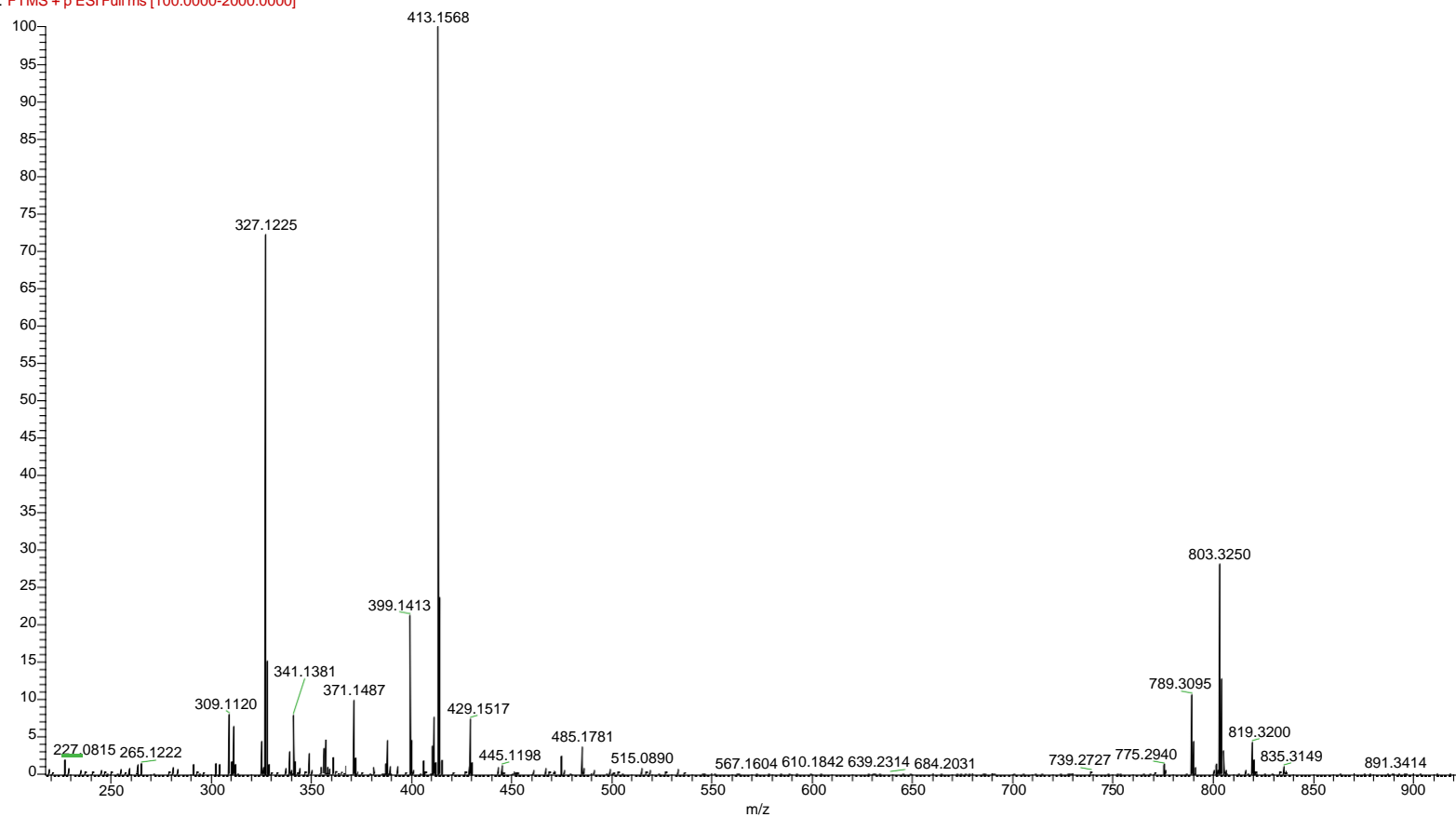


**Figure S192.** HSQC NMR spectrum of **18** in  $(\text{CD}_3)_2\text{SO}$ .

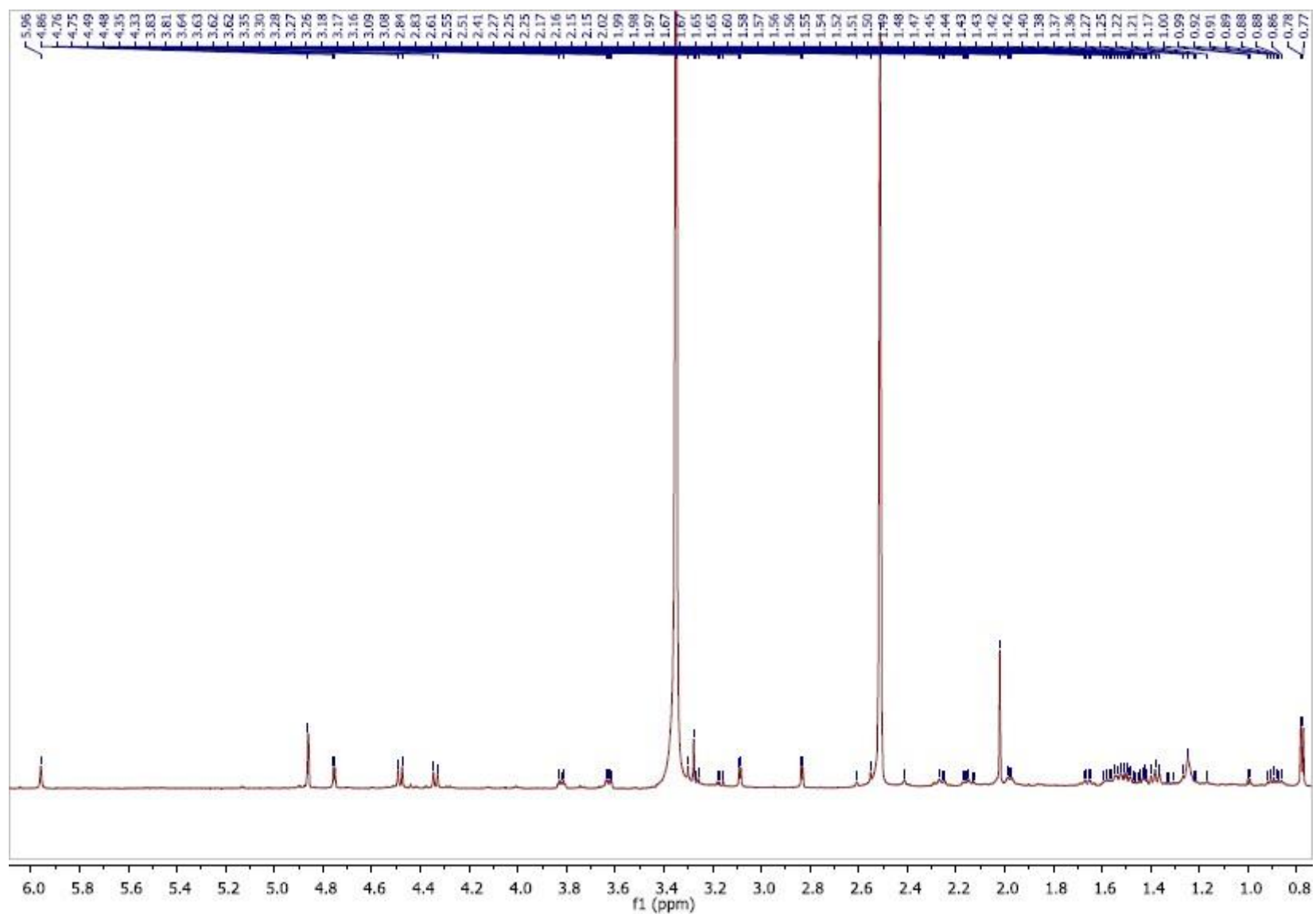


**Figure S193.** HMBC NMR spectrum of **18** in  $(\text{CD}_3)_2\text{SO}$ .

R2 #304-333 RT: 4.37-4.77 AV: 15 NL: 1.06E7  
F: FTMS + p ESI Full ms [100.0000-2000.0000]

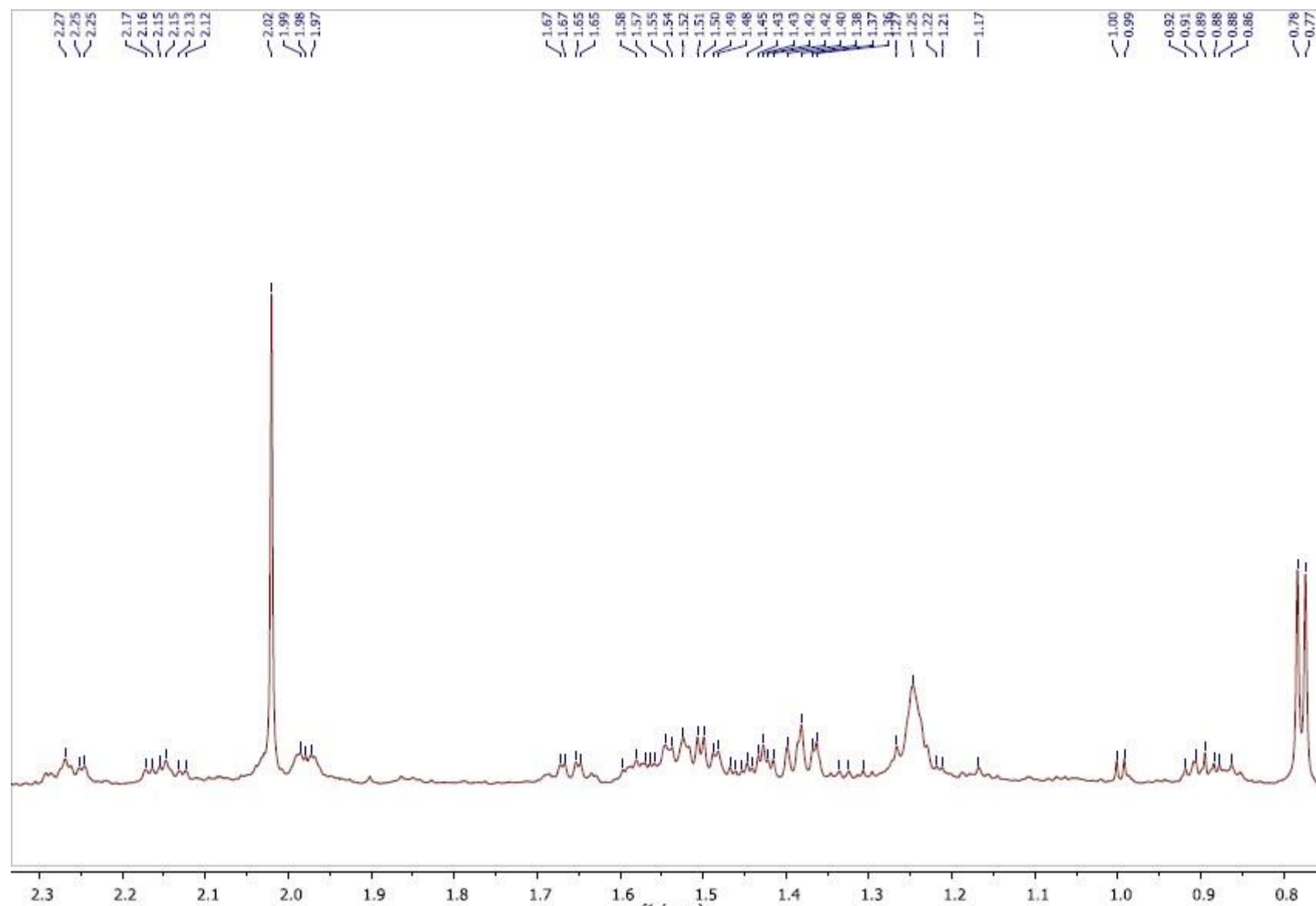


**Figure S194.** Positive-ion HRESIMS of **18**.

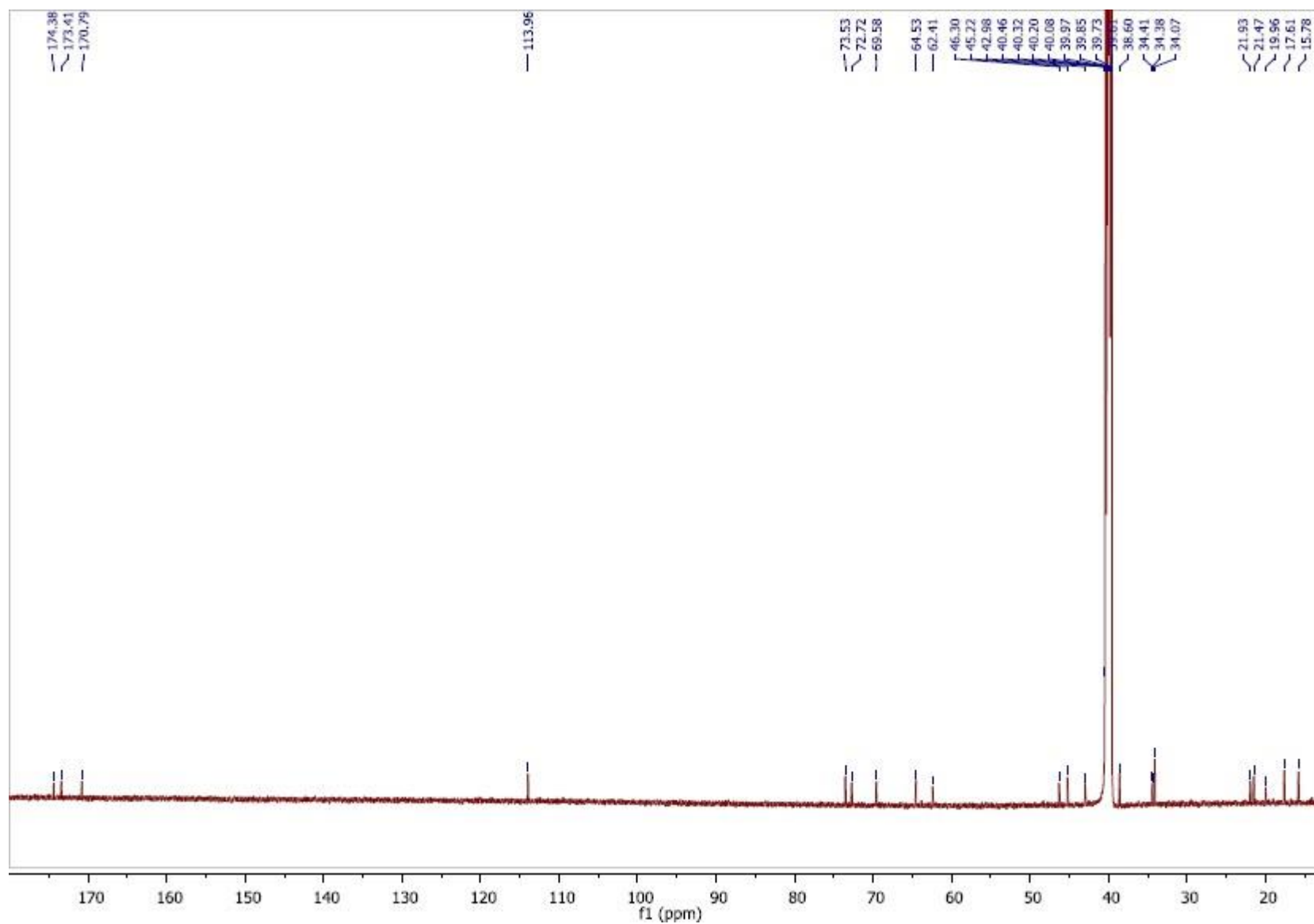


**Figure S195.**  $^1\text{H}$  NMR spectrum of **19** in  $(\text{CD}_3)_2\text{SO}$ .

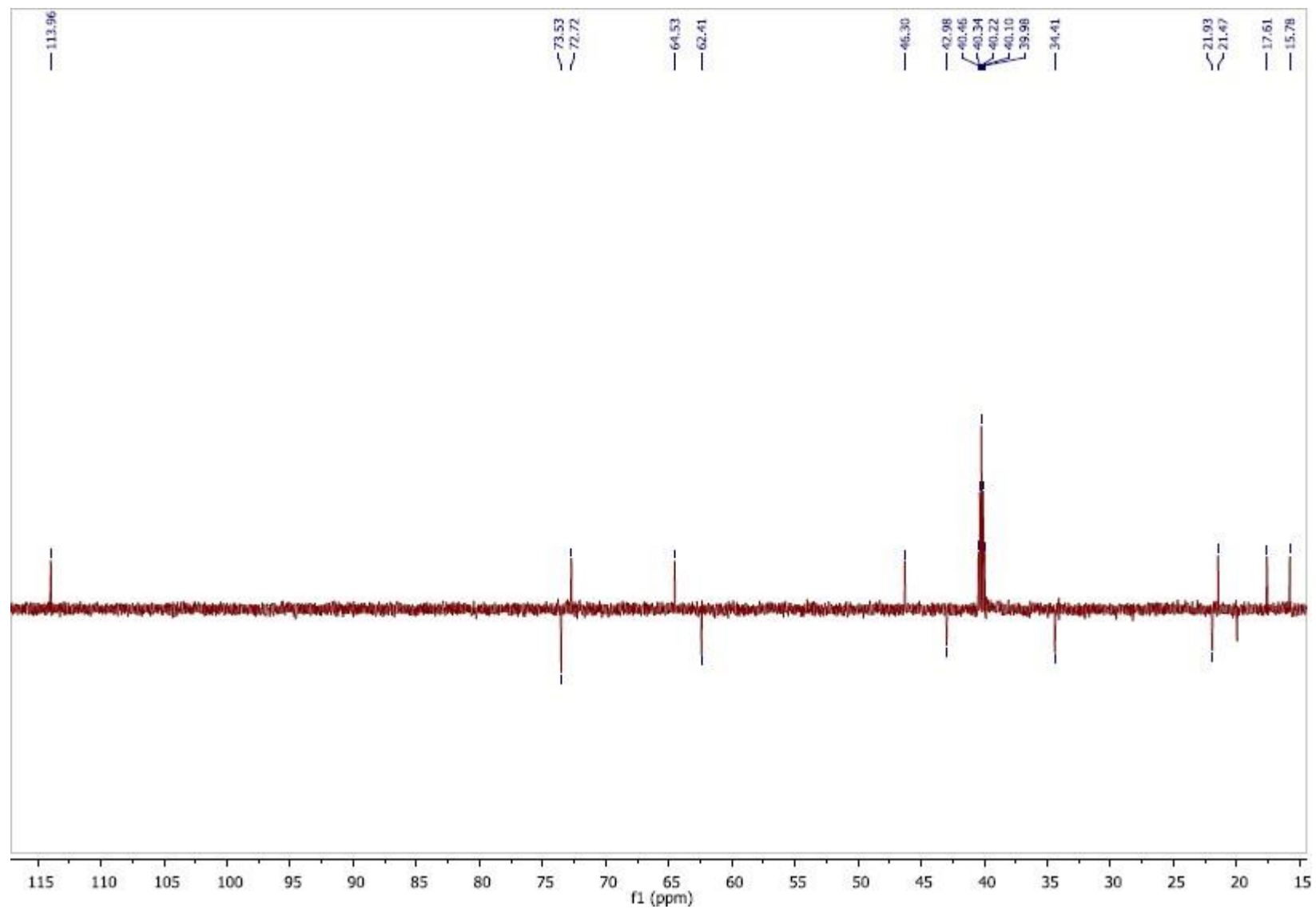




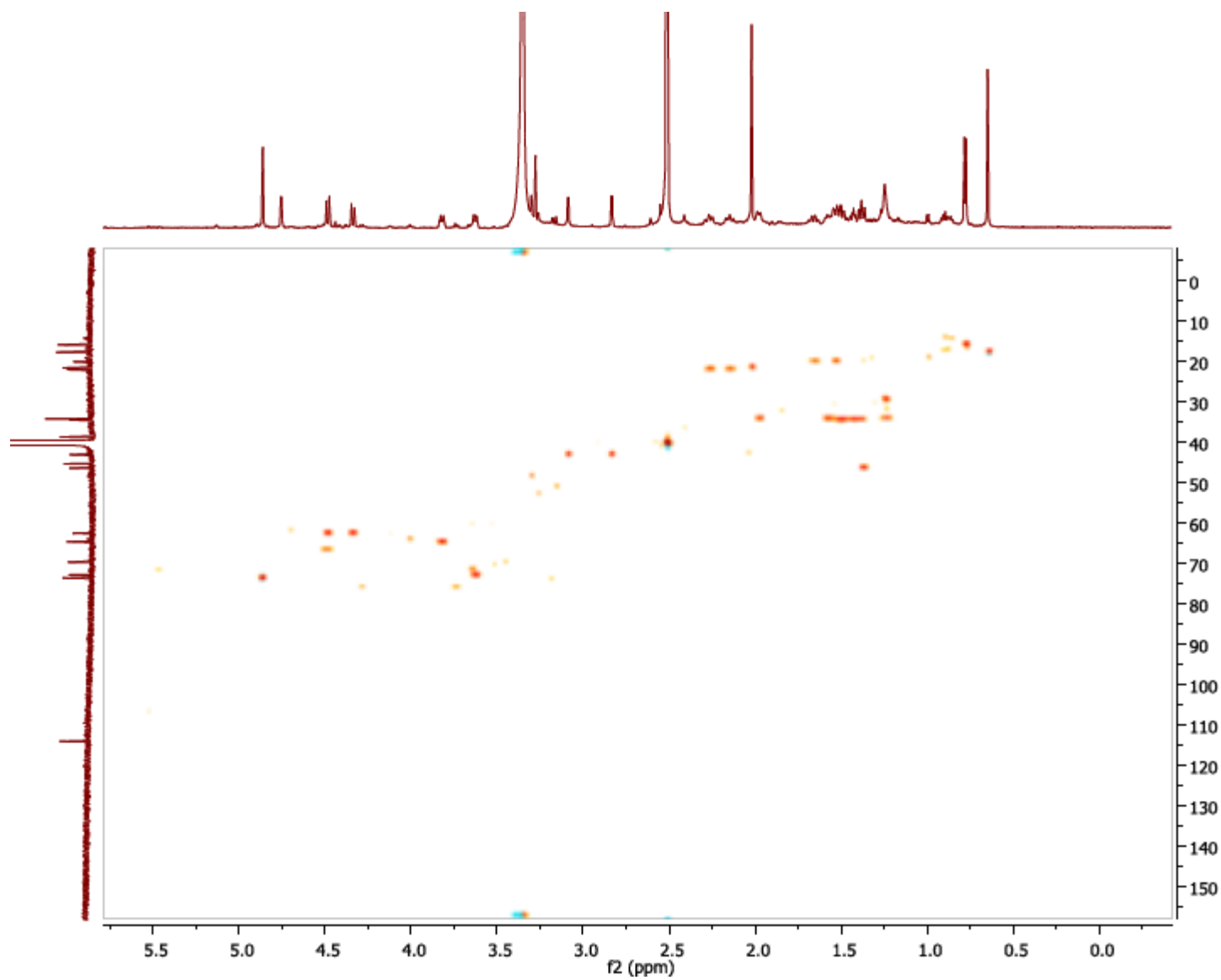
**Figure S196.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.75 –  $\delta$  2.3) of **19** in  $(\text{CD}_3)_2\text{SO}$ .



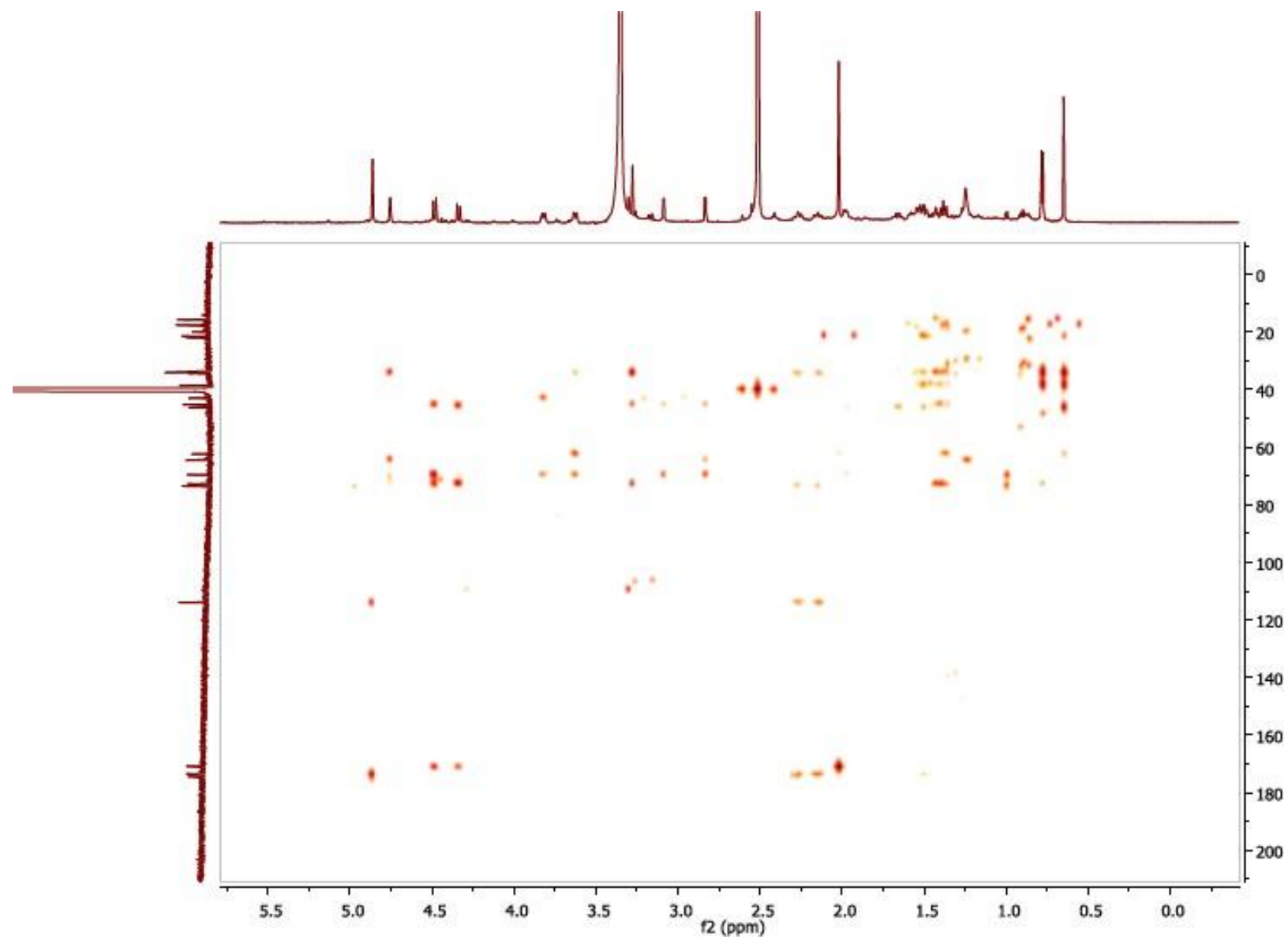
**Figure S197.** <sup>13</sup>C NMR spectrum of **19** in (CD<sub>3</sub>)<sub>2</sub>SO.



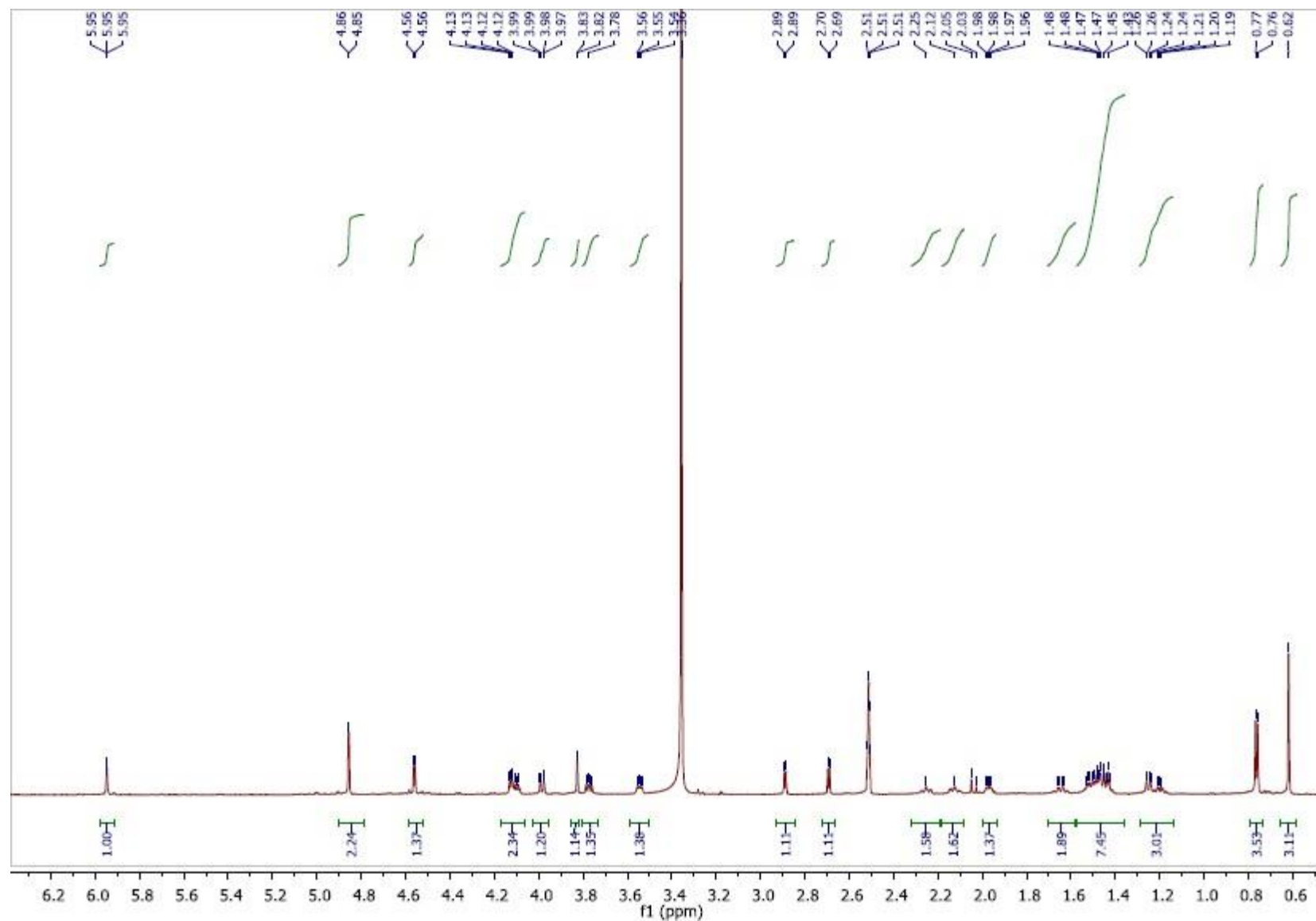
**Figure S198.** 135DEPT NMR spectrum of **19** in  $(\text{CD}_3)_2\text{SO}$ .



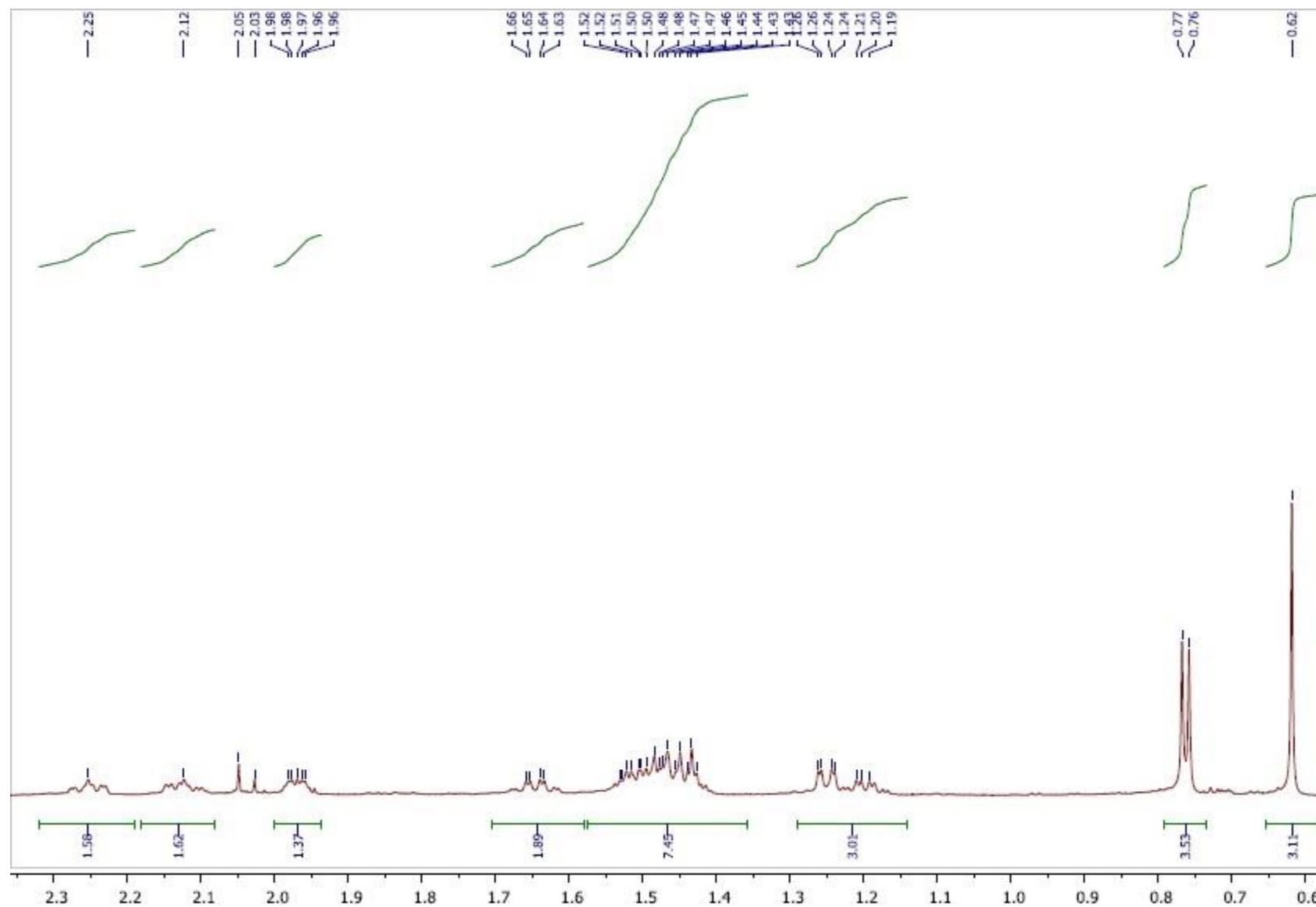
**Figure S199.** HSQC NMR spectrum of **19** in  $(\text{CD}_3)_2\text{SO}$ .



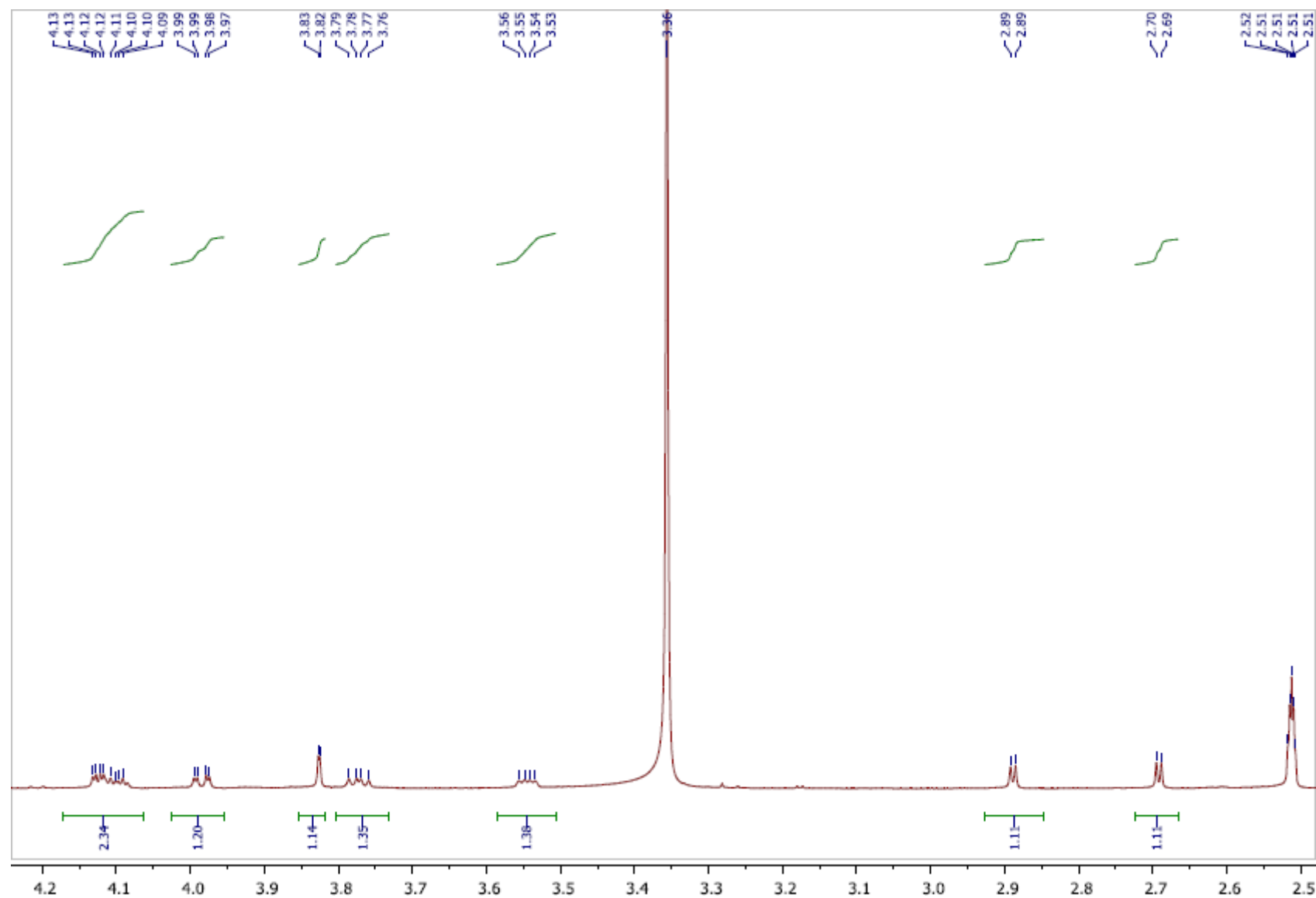
**Figure S200.** HMBC NMR spectrum of **19** in  $(\text{CD}_3)_2\text{SO}$ .



**Figure S201.**  $^1\text{H}$  NMR spectrum of **20** in  $(\text{CD}_3)_2\text{SO}$ .

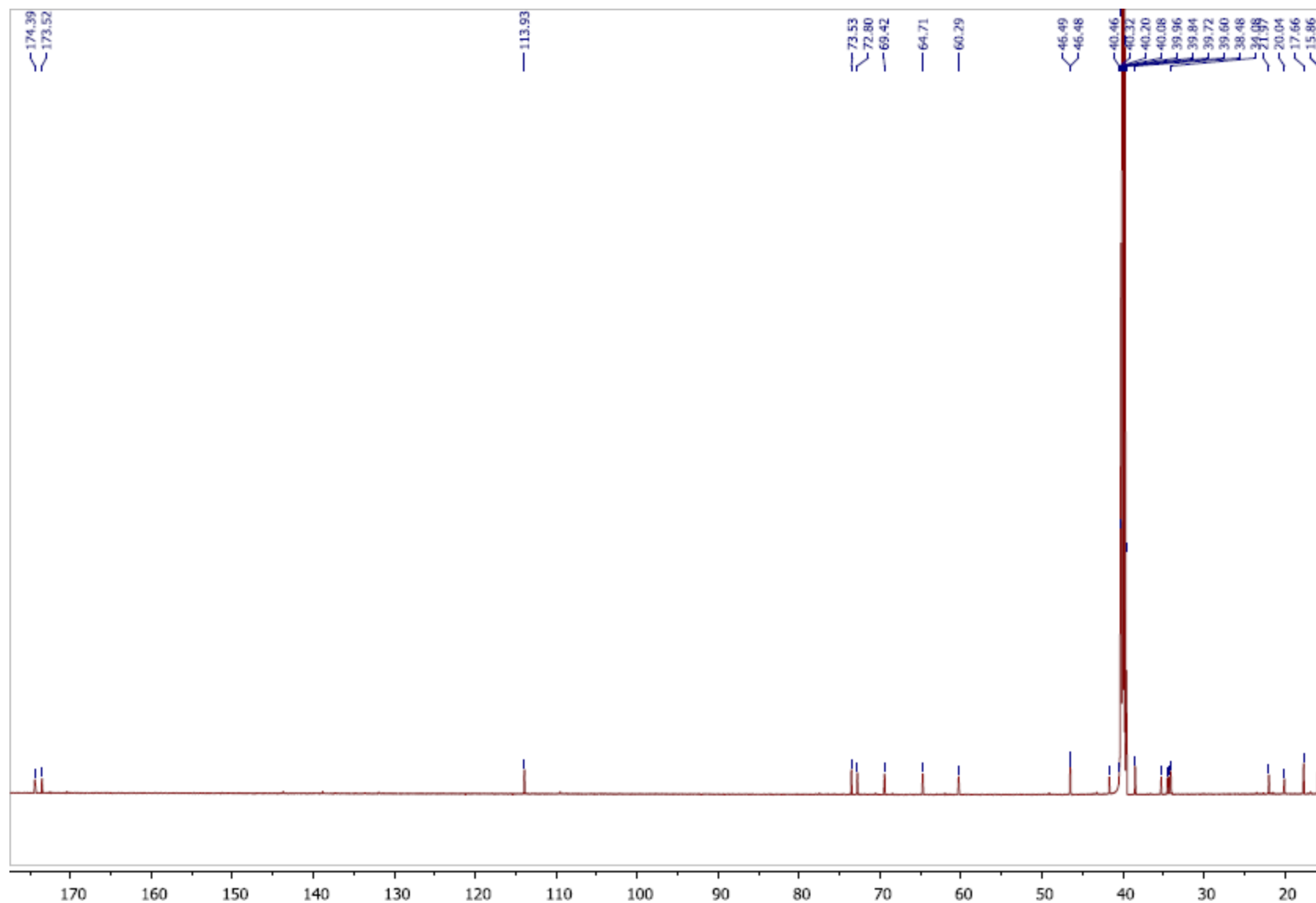


**Figure S202.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  0.6 –  $\delta$  2.3) of **20** in  $(\text{CD}_3)_2\text{SO}$ .

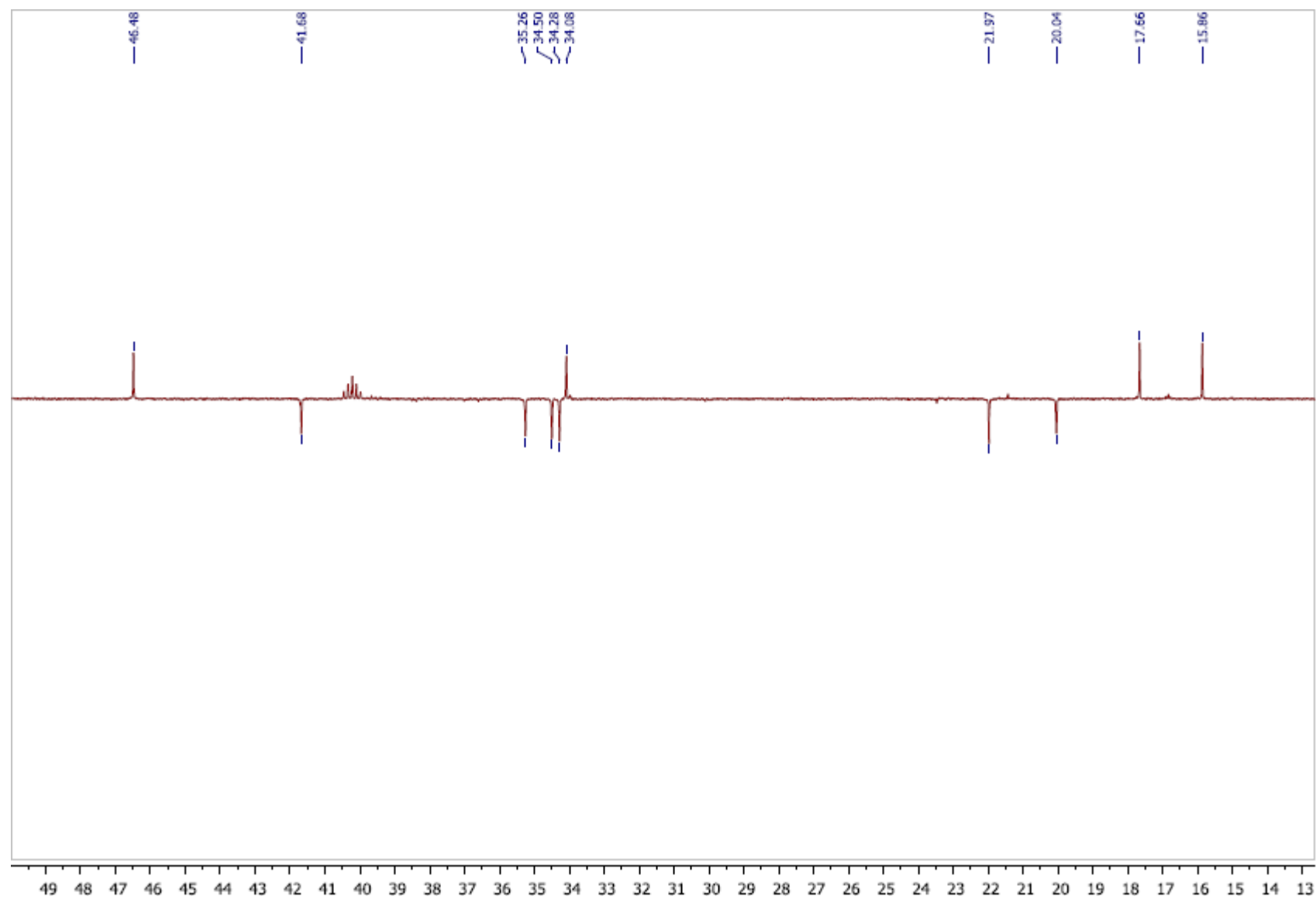


**Figure S203.** Expansion of part of  $^1\text{H}$  NMR spectrum ( $\delta$  2.5 –  $\delta$  4.2) of **20** in  $(\text{CD}_3)_2\text{SO}$ .

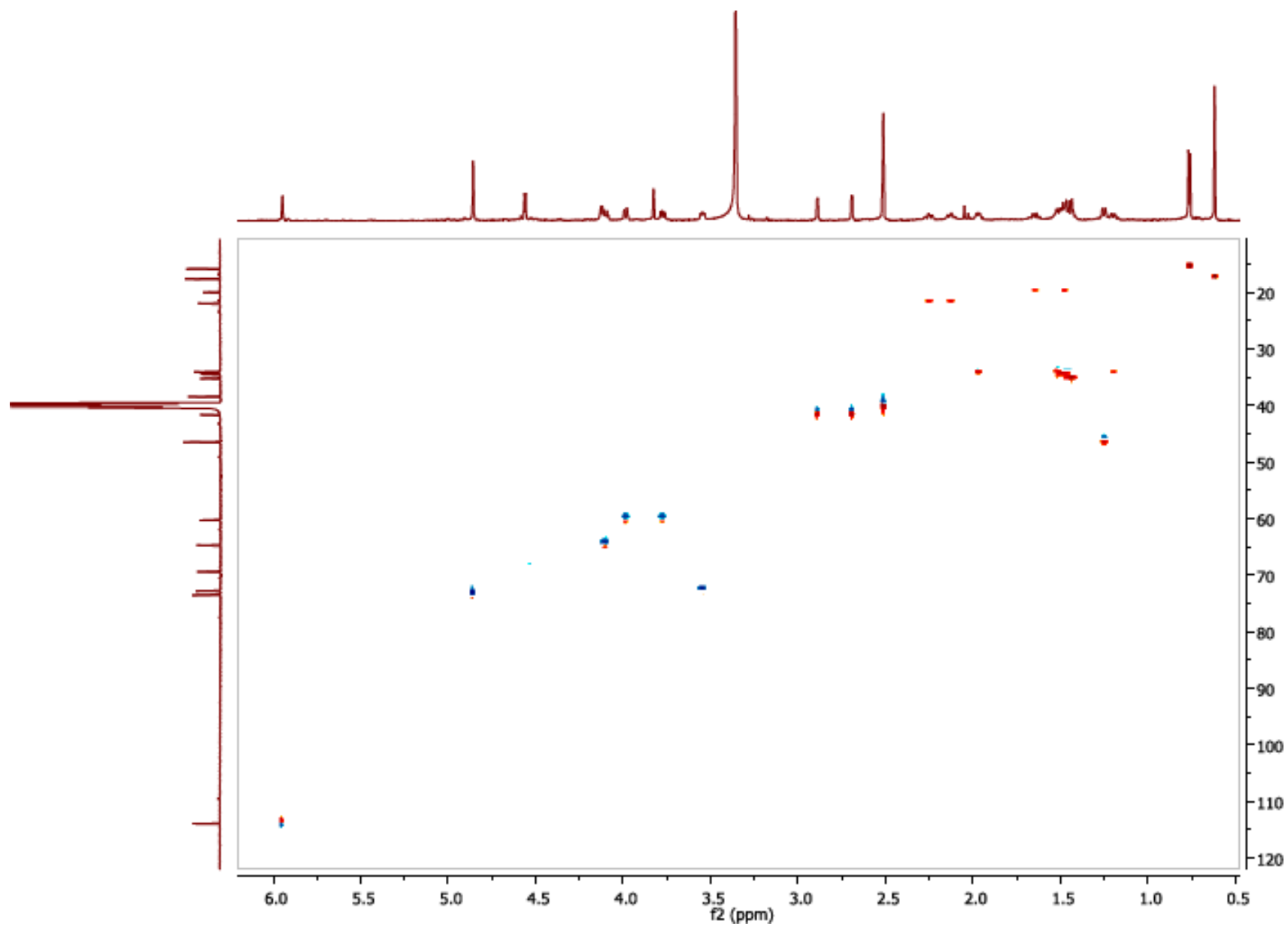




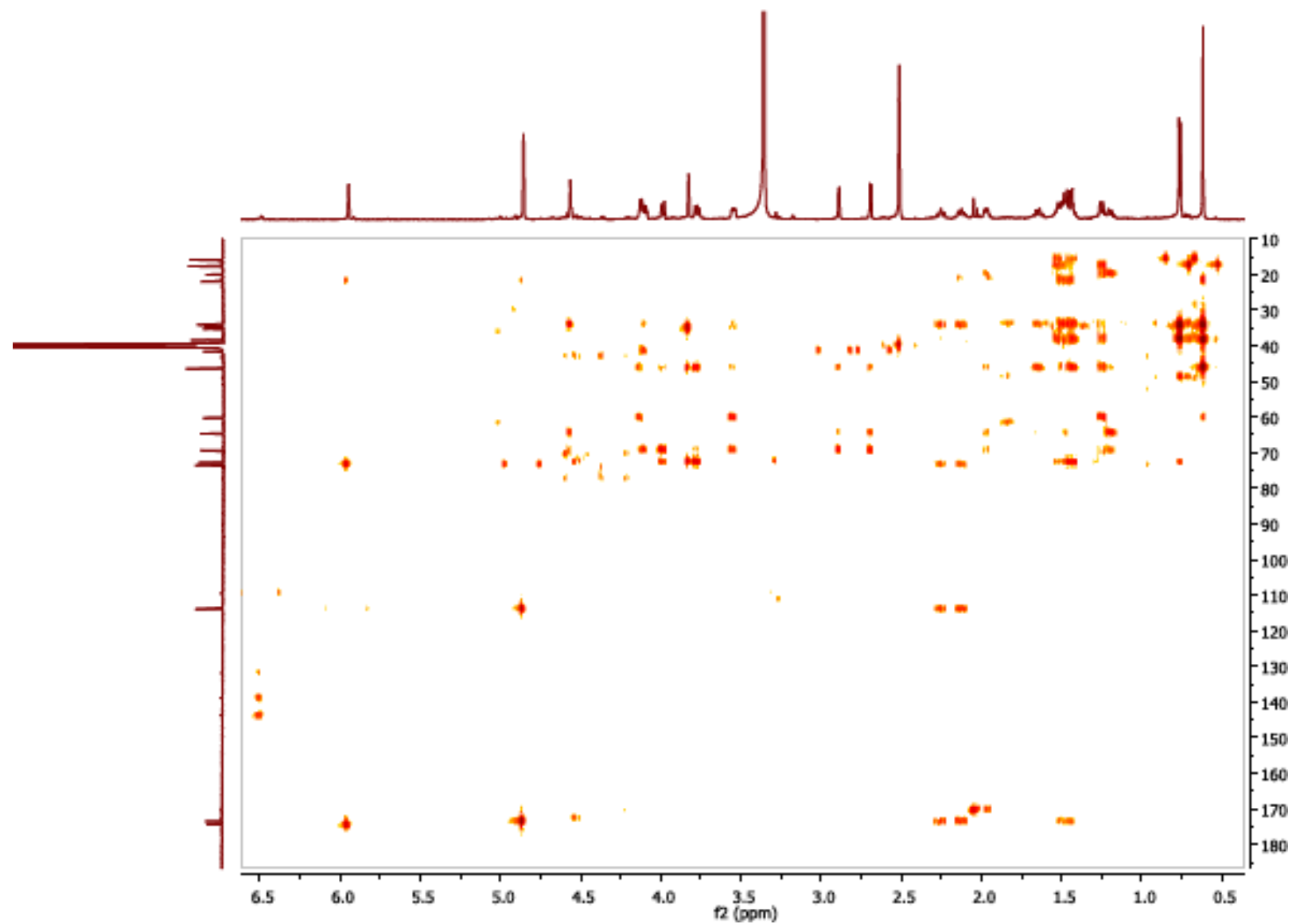
**Figure S204.** <sup>13</sup>C NMR spectrum of **20** in (CD<sub>3</sub>)<sub>2</sub>SO.



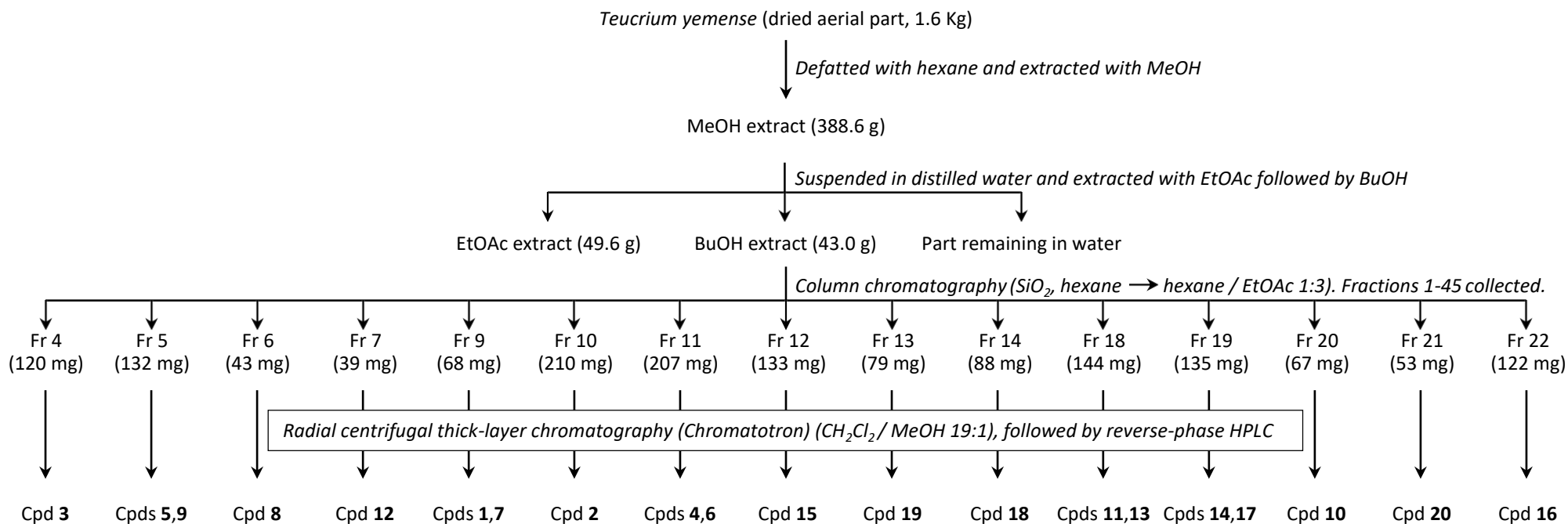
**Figure S205.** 135DEPT NMR spectrum of **20** in  $(\text{CD}_3)_2\text{SO}$ .



**Figure S206.** HSQC NMR spectrum of **20** in  $(\text{CD}_3)_2\text{SO}$ .



**Figure S207.** HMBC NMR spectrum of **20** in  $(\text{CD}_3)_2\text{SO}$ .



**Figure S208.** Fractionation tree for isolation of compounds 1-20.

## General analytical and chromatographic procedures.

The 1D and 2D NMR experiments ( $^1\text{H}$ ,  $^{13}\text{C}$ , COSY, NOESY, HSQC and HMBC) were performed on Bruker Avance spectrometers (500 MHz or 400 MHz for  $^1\text{H}$  and 175 MHz for  $^{13}\text{C}$  NMR spectra), using the residual solvent signals as internal standards. Conventional pulse sequences were used for COSY, NOESY, HSQC and HMBC. Coupling constants ( $J$ ) are stated in Hz. Ultra-high accuracy mass analysis was done on a Nano-Flow linear trap quadrupole Fourier Transformation Ion Cyclotron Resonance Mass Spectrometer Ultra (FT-ICR-MS) (“ultra” refers to the high-sensitivity ICR cell) (Triversa Nanomate; Advion Biosciences Limited, Norfolk, UK). Samples were reconstituted in 70% aq. MeOH (100  $\mu\text{L}$ ). Samples were vortexed and were centrifuged for 4 min at 13,000 rpm at  $0^\circ\text{C}$ . Aliquots (20  $\mu\text{L}$ ) of supernatant was then transferred to a clean well on a 128- well plate. The sample (13  $\mu\text{L}$ ) was injected by the nano-flow injection system, with an aliquot (5.0  $\mu\text{L}$ ) being delivered to the ICR cell. Gas pressure was maintained at 0.5 psi with an applied voltage of 1.5 KV to maintain a consistent current of 60-120 nA. When operating in narrow SIM mode, the resolution was 100,000 and the scan window 30 Da. Each scan was acquired in 60 sec. IR spectra were recorded on a Perkin- Elmer FTIR 600 series spectrometer. Column chromatography was performed using normal-phase silica gel (Merck; 230-400  $\mu\text{m}$ ). HPLC was performed on a Shimadzu system (Kyoto, Japan), consisting of two LC-6AD Semi-Preparative Solvent Delivery pumps coupled with Rheodyne manual injector, communications bus module CBM-20A, a multi-wavelength photo-diode array detector (SPD-M20A), FRC-10A fraction collector, all connected to a computer system with Intel Core DUO with Microsoft XP and Shimadzu’s LC solution software. It was fitted with two columns, Shim-pack PREP-ODS (H) Kit (A) 250 mm  $\times$  4.6 mm i.d., 5  $\mu\text{m}$  particles (B) 250 mm  $\times$  20 mm i.d., 5  $\mu\text{m}$ . Analytical HPLC was performed using the column under gradient conditions with a mobile phase consisting of MeCN and water programmed linearly to 100% MeCN over 35 min at the flow rate 1.0 mL  $\text{min}^{-1}$ . The UV detection wavelengths were 210 and 254 nm. The chromatographic separation HPLC was performed using column and preparative HPLC conditions as for analytical HPLC, except the flow rate was 20 mL  $\text{min}^{-1}$ .

## Assay for enhancement of insulin secretion.

Tolbutamide (TB), collagenase V and bovine serum albumin (BSA) were obtained from Sigma (St. Louis, MO, USA). The mouse ultrasensitive insulin ELISA kit was purchased from Crystal Chem Inc. (IL, USA).

*Isolation of murine pancreatic islets.* Primary pancreatic islets were isolated from male BALB/c mice (28-36 g) from the ICCBS Animal Research Facility. The animal handling and tissue harvesting were done in accordance with the requirements of the Institutional Animal Care and Use Committee of ICCBS, University of Karachi, Pakistan. Pancreatic islets were isolated by digestion with collagenase V and islet-picking, as described earlier.<sup>50,51</sup> Mice were anaesthetized with sodium thiopental (30 mg Kg)<sup>-1</sup> and the distended whole pancreas was digested at 37°C in collagenase solution (1.0 mg mL<sup>-1</sup>) for 15 min. The digested islets were further purified by centrifugation at 1000 rpm for 1 min, followed by filtration using a pre-wetted 70 µm cell strainer. Islets were hand-picked with a siliconized Pasteur pipette under a NIKON SMZ-745 stereomicroscope. The isolation and purification medium used was Hank's Balanced Salt Solution (HBSS) without Ca<sup>2+</sup>, Mg<sup>2+</sup> and phenol red.

*Assay.* Freshly isolated islets (n = 3) of similar diameter (120–160 µm) were pre-incubated for 45 min at 37°C in Krebs-Ringer bicarbonate (KRB) buffer solution containing 0.1% BSA and glucose (3.0 mM) in Eppendorf tubes, and each condition was triplicated. Then islets were washed with KRB buffer before transferred into KRB buffer (300 µL) containing glucose (16.7 mM), supplemented with either test compound (200 µM) or tolbutamide (positive control) (200 µM) and incubated at 37°C for 1 h. After incubation, an aliquot (200 µL) of the mixture was cooled to -40°C until it could be assayed for released insulin. The concentrations of insulin in the collected aliquots were measured using the mouse ultrasensitive insulin ELISA kit according to the high-range protocol. The reading is the concentration of insulin in ng mL<sup>-1</sup> of medium. After calculation of the absolute amount of insulin in the medium, this amount was divided by three (the number of islets in the tube).

## References

50. Siddiqui, B. S. *et al.* Two new compounds from the aerial parts of *Bergenia himalaica* Boriss and their anti-hyperglycemic effect in streptozotocin-nicotinamide induced diabetic rats. *J. Ethnopharmacol.* **152**, 561-567 (2014).
51. Hafizur, R. M., Hameed, A., Shukrana, M., Kabir, N., Chishti, S. Cinnamic acid exerts anti-diabetic activity by improving glucose tolerance *in vivo* and stimulating insulin secretion *in vitro*. *Phytomed.* **22**, 297-300 (2015).